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IDENTIFIERS	Energy Audits; Energy Extension Agents

ABSTRACT

This third of four sections in a curriculum guide for training energy extension agents contains general introductory materials, an overview of the total curriculum, and four modules: Energy Cost Calculations, Energy Use Survey: Procedure and Techniques, Field Observations (Practicum), and Energy Use Surveys (Practicum). The curriculum is designed for adults with at least eighth grade reading and math skills but without previous technical training. Following a brief description of the project which developed the curriculum (Project EFFECT--Energy for the Future: Education, Conservation, Training), these supplementary materials are provided: energy extension agent competencies, core curriculum outline, and class calendar for the eight-month program. Purpose of the modules is to enable students to conduct energy use surveys on residential or light commercial structures which include (1) surveying all systems in a structure, (2) calculating energy use and costs, (3) recommending appropriate energy conservation changes, (4) figuring payback on investment, and (5) reporting to owner of structure so that he can make effective use of the information. Contents of each module include objectives; teaching/learning activities, resources, and evaluation (quizzes and examinations) keyed to the objectives; and syllabi containing descriptions of content on a class-by-class basis. Also included in ERIC are a volume containing sample worksheets, handouts, and examinations for each module as well as full references to all outside sources needed; other sections of the guide; and a final report of the project--see Note. (YLB)

CE 025 102

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PROJECT EFFECT

Energy For The Future: Education, Conservation, Training

CURRICULUM GUIDE

for the training of

ENERGY EXTENSION AGENTS

A WORKING PAPER

Section III

Energy Audit Preparation

October 1979

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PROJECT EFFECT

Curriculum Guide for Training

ENERGY EXTENSION AGENTS

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PROJECT EFFECT

Curriculum Guide For Training

ENERGY EXTENSION AGENTS

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PROJECT EFFECT

CURRICULUM GUIDE

INTRODUCTION

Objectives and Activities

The most critical problem facing mankind in the near future is making the best use of our precious energy resources. The problem is first to change the attitudes of people about energy use. Particularly in the United States, the idea of unlimited, inexpensive energy for all must give way to conservative, thoughtful use of limited energy resources. Once people become aware of the need for immediate action to prevent drastic hardship in the future, they require reliable and unbiased information upon which to act. As resources dwindle and technology advances, the public must be kept informed of new developments so that they can continue to use energy effectively.

In its effort to address the need for technically trained manpower and informed citizens, Project EFFECT developed objectives in the three basic areas of Curriculum Development, Training, and Community Education, as follows:

1. To create a comprehensive training program for adults without previous technical training, applicable to community energy conservation needs, and usable in other communities in a variety of regions.

2. To define the new occupational role of Energy Extension Agent and to provide training for this agent, who would become a new community resource.

3. To heighten community awareness of energy conservation.

To meet these objectives, the project engages in the following major activities:

1. Production of a package of training materials on energy utilization and management, tested both with trainees and the community participants;

2. Selection and training of a team of Energy Extension Agents;

3. Placing the Energy Extension Agents in local agencies and organizations and businesses as energy utilization technicians;

4. Application of energy conservation techniques in the community through residential audits and community, neighborhood and agency workshops;

5. Establishment of a community resource file of people and agencies;

6. Promotion of community education about energy utilization through local, regional and national media emphasis;

7. Delivery of materials and workshops outside of the immediate project region.

Two additional major components in the area of technical assistance and curriculum evaluation and dissemination are:

1. Short term workshops, seminars, and institutes are conducted for technical personnel, utilities, public and governmental agencies, and include continuing education for Project graduates;

2. Regional and national conferences are conducted to evaluate the training program and to share curriculum development activities with others in the field.

An advisory committee made up of professionals from local business, industrial, educational and governmental institutions give valuable guidance in shaping the curriculum and in recruiting teaching staff from outside the university. In particular, much of the practical instruction in heating and cooling, insulation, and building codes is conducted with the help of community professionals in these fields.

The Project is funded by the U.S. Office of Education, Community Service and Continuing Education Branch, under a Title I grant.

Progress and Accomplishments

Since project start-up in October 1977, an eight-month curriculum has been developed and field-tested with two groups of trainees. The July 1978 class was entirely supported by three local CETA agencies (South Bend, St. Joseph County, and Elkhart County) and sixteen students were graduated. The 1979 class included some students funded by CETA (South Bend and St. Joseph County) but most class members were self-supporting. Ten were graduated in July 1979. Graduates are employed with governmental agencies, community action agencies, construction firms, architectural contracting firms and insulation contractors. Other placement opportunities are being developed in city-government, state energy offices, local industry and educational systems, and utilities.

In addition, Project EFFECT staff has conducted pilot two-day workshops for the South Bend Community School Corporation's physical plant superintendents and staff and for Indiana and Michigan Electric Company field representatives.

Additional activities include an energy curriculum evaluation workshop held in 1978. A small task force representing Federal offices, curriculum development and training programs and energy conservation experts was invited to conduct an intensive critique of the EFFECT curriculum. Second year revisions in the training program were based on their suggestions as well as on the lessons learned from the first training session.

Finally Project Staff is developing a series of workshops for the Indiana State Energy Group in five sites throughout Indiana. The workshops will enable local education agencies and hospitals to conduct energy audits of their facilities in order to qualify for Federal aid to institute energy-conserving changes.

ORGANIZATION OF CURRICULUM GUIDE

The curriculum materials are organized into four main sections and color coded as follows:

Section I - General Background (gold)
Section II - Technical Training (green)
Section III - Energy Audit Preparation (buff)
Section IV - Community Education (blue)

Each section contains general introductory materials and an overview of the total curriculum. Within each module are included objectives, resources and references, a class syllabus keying each session to the objectives, and evaluation materials such as final exams or descriptions of other evaluation strategies.

SUPPLEMENTARY MATERIALS

COMPETENCIES OF THE ENERGY EXTENSION AGENT

The Project EFFECT curriculum is designed to develop the technical and communication skills necessary to conduct an energy use survey and to explain the results of the survey to the general public. Upon completion of this eight month program, the Project EFFECT graduate can:

Conduct an energy use survey of a residential or light commercial structure, which includes:

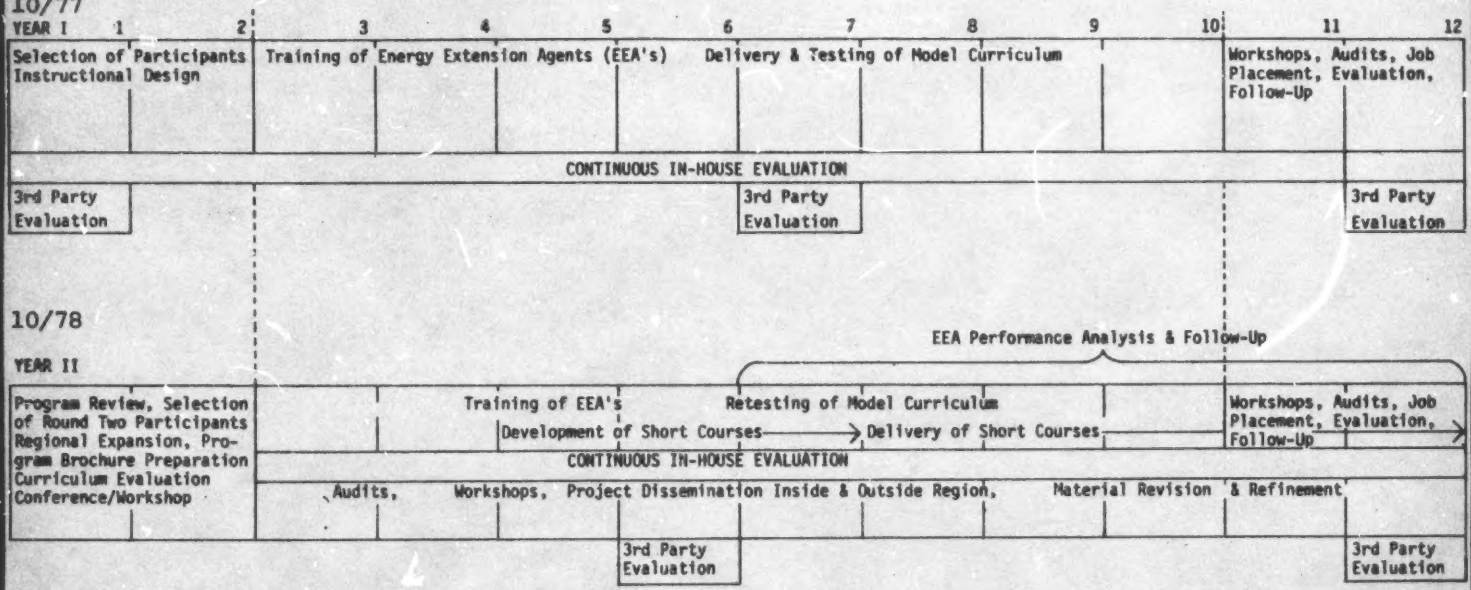
- ....a simple sketch of the structure, including plan and elevation views, showing all relevant details;
- ....an exact accounting of heat losses and heat gains due to infiltration and conduction through floors, ceilings, windows and walls;
- ....an analysis of existing insulation and ventilation and recommendations regarding the need for more or less of each;
- ....a full description of heating, cooling, hot water, lighting and appliance systems;
- ....a two year billing audit which considers fuel consumption and cost for space heating and cooling, domestic hot water, electrical equipment and other appliance systems;
- ....consultation with homeowner to recommend possible energy conservation opportunities, in order of priority, and the payback period on these investments.

Conduct an energy conservation workshop for community, professional and lay organizations, which includes:

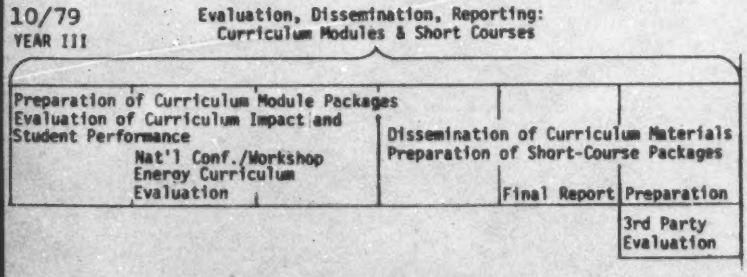
- ....information on energy conservation methods (a breakdown of energy uses in the home, from largest to smallest, in terms of energy consumption and suggestions on how to cut down on usage);
- ....displays of different types of insulation with R-values on each and recommended usage according to specific need;
- ....displays of various types of weatherstripping and caulking and recommended usage of each;
- ....charts showing R-values on various materials and water usage in a typical home;
- ....general information on alternate energy sources;
- ....general discussions on energy related questions generated from the audience as a result of information presented.

PROJECT EFFECT

TIME LINE



10/78
YEAR II
EEA Performance Analysis & Follow-Up
Program Review, Selection of Round Two Participants
Regional Expansion, Program Brochure Preparation
Curriculum Evaluation Conference/Workshop
Training of EEA's
Development of Short Courses
Retesting of Model Curriculum
Delivery of Short Courses
Workshops, Audits, Job Placement, Evaluation, Follow-Up
CONTINUOUS IN-HOUSE EVALUATION
Audits, Workshops, Project Dissemination Inside & Outside Region, Material Revision & Refinement
3rd Party Evaluation
3rd Party Evaluation



PROJECT EFFECT

CORE CURRICULUM

DIDACTIC INSTRUCTION (6 MONTHS)

SECTION 1 - General Background

Module		Hours
Mathematics Review		17
Basic Writing		9.5
Energy Overview		68.5
	Total	95

SECTION 2 - Technical Training

Module		Hours
Basic Graphics and Blueprint Reading		89
Building Materials		20.5
Electricity		14
Alternative Energy Sources (Solar and Wood)		24.5
Introduction to Cooling Systems		23
Introduction to Heating Systems		37
Insulation and Ventilation		18
Lighting Efficiency		20
	Total	246

SECTION 3 - Energy Audit Preparation

Module		Hours
Energy Cost Calculations		16.5
Energy Use Survey: Procedure and Techniques		46
	Total	62.5

SECTION 4 - Community Education

Module		Hours
How to Conduct Community Energy Education Projects; Small Group Dynamics; Use of media, etc.		97
Demography and Survey Skills		38
The Organization of State and Local Government		14
	Total	149

PROJECT EFFECT

CORE CURRICULUM

PRACTICUM (2 MONTHS)

	Hours
SECTION I - Field Observations	24
SECTION II - Community Education (Workshops)	12
SECTION III - Energy Use Surveys	111
SECTION IV - Miscellaneous Activities Independent Worktime Placement and Critique Testing and Graduation	49
Total	196
+ 6 month didactic	552.5
Complete Training Program =	748.5

PROJECT EFFECT

MONTHLY HOURS OF PROGRAM CONTENT (1978 - 79)

DIDACTIC PHASE

MODULE	DEC	JAN	FEB	MAR	APR	MAY	TOTAL HOURS
AREA I - GENERAL BACKGROUND							
Mathematics Review	3	8	6				17
Basic Writing	3	5.5	1				9.5
Energy Overview	11	35.5	12.5	9.5			68.5
AREA II - TECHNICAL TRAINING							
Graphics and Blueprint Reading	9	34	24	22			89
Building Materials		6	13.5	1			20.5
Electricity			9	5			14
Alternative Energy Sources (Solar and Wood)			24.5				24.5
Introduction to Cooling Systems						23	23
Introduction to Heating Systems					37		37
Insulation and Ventilation				9	9		18
Lighting Efficiency				2.5	17.5		20
AREA III - ENERGY AUDIT PREP.							
Energy Cost Calculations					8.5	8	16.5
Energy Survey						46	46
AREA IV - COMMUNITY EDUCATION							
Community Education	46.5	8	4.5	5	15	18	97
Demography and Survey Skills		10.5	13.5	14			38
State and Local Government				4	10		14
TOTALS	72.5	107.5	108.5	72	97	95	552.5

PROJECT EFFECT

PRACTICUM HOURS PER WEEK (JUNE - JULY, 1979)

	1	2	3	4	5	6	7	8	Module totals
FIELD OBSERVATIONS	15	3	3						21
COMMUNITY EDUCATION (WORKSHOPS)		3	9						12
ENERGY USE SURVEYS	6	15	6	24	18	24	24	18	135
MISCELLANEOUS: INDEPENDENT WORKTIME	6	6	6	3	3	3			27
PLACEMENT ACTIVITIES	4		4	3		3	3		17
TESTING AND GRADUATION							1	12	13
TOTAL CLASS HOURS	31	30	28	30	21	30	28	18	225

[redacted]BER [redacted] THROUGH JANUARY [redacted]

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK # 1	11 ORIENTATION 9-10 Intro and greetings - staff 10-12 Group Intro (Mosel) 12-1 Lunch 1-2:30 Logistics 2:30-4 Reception	12 9-12 Report Writing 11-12 Library Tour 1-2 Energy Pre-Test 2-4 Team Building (Mosel)	13 9-10:30 Algebra Review 10:30-12 Energy Overview 1-3:30 Energy Overview (Term Search)	14 9-12 Study Skills 1-4 Time Management Skills (Mosel)	15 9-11 Energy Overview 11-12 Community Education 1-3 Evaluation
WEEK # 2	18 9-12 Basic Graphics and Blueprints 1-2:30 Report Writing 2:30-4 Worktime	19 9-12 TABE TESTING at Goodwill Indust. 1-4 Energy Overview (Slide show)	20 9-12 Basic Graphics and Blueprints 1-2:30 Algebra 2:30-4 Worktime	21 9-10:30 Study Skills 10:30-12 Report Writing 1-3:00 Energy Overview	22 9-11 Basic Graphics and Blueprints 11-12 Comm. Ed. 1-3 Evaluation
WEEK # 3	25 CHRISTMAS	26 BREAK	27 ALL	28 WEEK	29 !!!
WEEK # 4	1 NEW YEARS DAY	2 9-10:30 Algebra Review 10:30-12 Report Writing 1-4 Energy Overview	3 9-11 Basic Graphics and Blueprints 11-12 Algebra 1-3 Energy Overview 3-4 Worktime	4 DAT TESTING ALL DAY	5 9-11 Basic Graphics and Blueprints 11-12:30 Demography 1:30-3:30 Evaluation

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PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK # 5	8 9-11 Basic Graphics 11-12:30 Bldg. Mats. 1:30-3 Energy Overview 3-4 Worktime	9 9-12 Energy Overview (Twin Branch field trip) 1-2:00 Algebra 2:00-4 Comm. Ed.	10 9-11 Basic Graphics 11-12 Report Writing 1-3 Energy Overview 3-4 Worktime	11 9-12 Building Mats. 1-4 Demography	12 9--1 Basic Graphics 11-12:30 Demography 1:30-3:30 Evaluation
WEEK # 6	15 9-11 Basic Graphics Class dismissed after graphics	16 9-12 Energy Overview 1-2:30 Algebra 2:30-4 Comm. Ed.	17 9-11 Basic Graphics 11-12 Report Writing 1-3 Energy Overview 3-4 Worktime	18 9-4 Energy Overview (Field trip to Cook Nuclear Plant)	19 9-11 Basic Graphics 11-12:30 Comm. Ed. 1:30-3:30 Evaluation
WEEK # 7	22 9-11 Basic Graphics 11-12:30 Worktime 1:30-3 Energy Overview 3-4 Worktime	23 9-12 Energy Overview 1-2:30 Algebra 2:30-4 Comm. Ed.	24 9-11 Basic Graphics 11-12 Report Writing 1-3 Energy Overview 3-4 Worktime	25 9-4 Energy Overview 1-4 Demography	26 9-11 Basic Graphics 11-12:30 Demography 1:30-3:30 Evaluation
WEEK # 8	29 9-11 Basic Graphics 11-12:30 Bldg. Mats. 1:30-3 Energy Overview 3-4 Worktime	30 9-12 Energy Overview 1-2:30 Algebra 2:30-4 Comm. Ed.	31 9-11 Basic Graphics 11-12 Report Writing 1-3 Energy Overview 3-4 Worktime	1 9-4 Building Materials (Slide Show Presentation)	2 9-11 Basic Graphics 11-12:30 Demography 1:30-3:30 Evaluation

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PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK #9	5 9-11 Graphics 11-12:30 Bldg. Mats. 1:30-3:00 Energy Overview 3-4 Worktime	6 9-12 Energy Overview 11-12:00 Report Writing 1-2:30 Algebra 2:30-4 Comm. Ed.	7 9-11:00 Graphics 11-12 Electricity 1-3 Energy Overview (Solar)	8 9-12 Bldg. Mats. FIELD TRIP 1-4 Demography	9 9-11 Graphics 11-12:30 Demography 1:30-3:30 Evaluation
WEEK # 10	12 9-11 Graphics 11-12:30 Electricity 1:30-3 Energy Overview (solar) 3-4 Worktime	13 9-12 Energy Overview (solar) 1-2:30 Algebra 2:30-4 Comm. Ed.	14 9-11 Graphics 11-12:30 Electricity 1-3 Energy Overview (solar) 3-4 Worktime	15 SOLAR FIELD DAY (Rock Solar Home)	16 9-11 Graphics 11-12:30 Demography 1:30-3:30 Evaluation
WEEK # 11	19 9-11 Graphics 11-12:30 Electricity 1:30-3 Energy Overview (Solar) 3-4 Worktime	20 9-12 Energy Overview (solar) 1-2:30 Algebra 2:30-4 Demography	21 9-11 Graphics 11-12 Electricity 1-3 Energy Overview (Solar) 3-4 Worktime	22 9-12 Bldg. Mats. (Exam) 1-4 Demography	23 9-11 Graphics 11-12:30 Demography 1:30-3:30 Personal Interviews - Career Planning
WEEK # 12	26 9-11 Graphics 11-12:30 Electricity 1:30-3 (Wood) 3-4 Worktime	27 9-12 Energy Over view (Solar quiz) 1-2:30 Algebra (Exam) 2:30-4 Comm. Ed.	28 9-11 Graphics 11-12 Electricity 1-3 Energy Overview 3-4 Worktime	1 FIELD DAY (Bailly Power Plant)	2 9-11 Graphics 11-12:30 Demography 1:30-3:30 Evaluation

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK # 13	5 **********	6 **********S P	7 R I N G B R E A K	8 **********	9 **********
WEEK # 14	12 9-11 Graphics 11-12:30 Electricity 1:30-3 Energy Overview	13 9-12 Energy Overview 1-2 Comm. Ed. 2-4 Demography	14 9-11 Graphics 11-12 Electricity 1-3 Energy Overview (Hard-Soft Debate)	15 FIELD DAY GRAPHICS	16 9-12 Graphics SOUTH BEND ENERGY DAYS (SCOTTSDALE MALL)
WEEK # 15	19 9-11 Graphics 11-13:30 Electricity 1:30-3 Demography	20 8-11 Insulation 12-2 Energy Overview (final test) 2-4 Comm. Ed.	21 9-11 Graphics 11-12 Electricity (Exam) 1-3 State & Local Government	22 9-12 Insulation 1-4 Demography	23 9-12 Graphics 1-2 Job Readiness 2-3 Evaluation
WEEK # 16	26 9-11 Graphics 11-12:30 Lighting Demography cancelled	27 9-12 Insulation 1-2 Energy Overview 2-4 Comm. Ed.	28 9-11 Graphics 11-12 Lighting 1-3 State & Local Government	29 FIELD DAY (GRAPHICS)	30 9-12 Graphics 1-3 Evaluation

APRIL 2 THROUGH APRIL 27

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK #17	2 9-11 Heating 11-12:30 Lighting 1:30-3 Cost Calculations	3 9-12 Insulation (Field trip) 1-4 Insulation	4 9-11 Heating 11-12 Lighting 1-4 Communications Skills (Mosel)	5 9-12 Insulation (Exam) 1-3 State & Local Government	6 9-12 Heating 1-3:00 Resume Writing
WEEK #18	7 9-11 Heating 11-12:30 Lighting 1:30-3 Cost Calculations	8 9-12 Heating 1:30-4 State & Local Government (Public Safety Hearing)	9 9-11 Heating 11-12 Lighting	10 HEATING FIELD DAY	11 9-12 Heating GOOD FRIDAY AFT. FREE
WEEK #19	16 9-10 Worktime 10:30-12 Lighting 1-3 Cost Calculations	17 9-12 Heating 1-4 Communication Skills (Mosel)	18 9-11 Heating 11-12 Lighting 1-3 State & Local Government	19 LIGHTING ANALYSIS SURVEY	20 9-12 Heating 1-3 Resume Writing
WEEK #20	23 9-11 Heating 11-12:30 Lighting 1:30-3 Cost Calculations	24 9-12 Building Codes 1-4 Comm. Ed.	25 9-11 Heating 11-12 Lighting 1-3 State & Local Government	26 HEATING FIELD DAY	27 9-12 Heating 1-3 Evaluation

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PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK #21	30 9-11 Heating 11-12:30 Lighting (Test) 1-3 Cost Calculations	1 9-12 Building Codes 1-4 Comm. Ed.	2 9-12 Heating 1-3 Energy Surveys	3 9-12 Cost Calculations 1-4 Comm. Ed.	4 9-12 Heating 1-3 Evaluation
WEEK #22	7 9-12 Heating (exam) 1-3 Cost Calculations	8 9-12 Bldg. Codes 1-4 Comm. Ed.	9 9-12 Cooling 1-3 Energy Surveys	10 9-12 Cost Calculations 1-4 Comm, Ed.	11 9-12 Cooling TO BE ANNOUNCED
WEEK #23	14 9-12 Cooling 1-3 Energy Surveys	15 9-12 Energy Survey 1-4 Comm. Ed.	16 9-12 Cooling 1-3 Energy Surveys	17 9-12 Energy Surveys 1-4 Comm. Ed.	18 9-12 Cooling 1-3 Evaluation
WEEK #24	21 9-12 Energy Surveys 1-3 Cooling (exam)	22 ENERGY SURVEYS	23 ENERGY SURVEYS	24 ENERGY SURVEYS	25 NO CLASSES

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MAY 31 THROUGH JUNE 22

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK # 25	28 MEMORIAL DAY	29 ENERGY USE SURVEY 1-4	30 9-4 COOLING	31 WRAP-UP	1 ORIENTATION TO PRACTICUM
WEEK # 26	4 TEAM A - SUPERVISED AUDIT TEAM B - OBSERVATIONS	5 TEAM A - OBSERVATIONS TEAM B - SUPERVISED AUDIT	6 TEAM A - WORKTIME TEAM B - OBSERVATIONS	7 TEAM A - OBSERVATIONS TEAM B - WORKTIME	8 NORTHERN INDIANA PUBLIC SERVICE CO. (GAS) WORKSHOP (ALL) BROWN BAG LUNCH JOB READINESS
WEEK #27	11 TEAM A - COMPUTER INSTRUCTION TEAM B - SUPERVISED AUDIT	12 TEAM A - SUPERVISED AUDIT TEAM B - COMPUTER INSTRUCTION	13 TEAM A COMPUTER INSTRUCTION TEAM B - WORKTIME	14 TEAM A - WORKTIME TEAM B - COMPUTER INSTRUCTION P.M. - DEMO AND PRACTIVE DELIVERING AUDIT TO CLIENT	15 INDIANA & MICHIGAN WORKSHOP (ELECTRIC CO.) DRESS REHERSAL - ENERGY CONSERVATION WORKSHOPS
WEEK #28	18 SEMI-SUPERVISED AUDITS (in teams)	19 OPTIONAL OBSERVATION - TEAMS A & B WORKTIME	20 WORKTIME DRESS REHERSAL - ENERGY CONSERVATION WORKSHOPS	21 TEAM A - WORKSHOP AT "ACTION, INC" TEAM B - WORKSHOP AT "ACTION, INC." (evening)	22 CATCH-UP BROWN BAG LUNCH JOB READINESS

JUNE 25 THROUGH JULY 20

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK #29	25 START - ASSESSMENT OF AUDIT PERFORMANCE SEMI-SUPERVISED AUDITS	26 SEMI-SUPERVISED AUDITS	27 SEMI-SUPERVISED AUDITS	28 SEMI-SUPERVISED AUDITS	29 WORKTIME JOB READINESS
WEEK #30	2 INDEPENDENT AUDIT ASSESSMENT	3 INDEPENDENT AUDIT ASSESSMENT	4 INDEPENDENCE DAY NO CLASSES	5 INDEPENDENT AUDITS	6 WORKTIME JOB READINESS
WEEK #31	9 INDEPENDENT AUDITS	10 INDEPENDENT AUDITS	11 INDEPENDENT AUDITS	12 INDEPENDENT AUDITS	13 WORKTIME JOB READINESS
WEEK #32	16 INDEPENDENT AUDITS	17 INDEPENDENT AUDITS	18 INDEPENDENT AUDITS	19 INDEPENDENT AUDITS	20 ENERGY POST-TEST JOB READINESS

PROJECT EFFECT - CURRICULUM CALENDAR

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
WEEK # 33	23 INDEPENDENT AUDITS	24 INDEPENDENT AUDITS	25 INDEPENDENT AUDITS	26 DIFFERENTIAL APTITUDE TEST (DAT'S) ALL DAY	27 GRADUATION!!!
WEEK #					
WEEK #					
WEEK #					

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SECTION 3 - ENERGY AUDIT PREPARATION

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INTRODUCTION - SECTION III

Energy Audit Preparation

MODULES:

Energy Cost Calculations

Energy Use Survey: Procedure and Techniques

Field Observations (Practicum)

Energy Use Surveys (Practicum)

A primary objective of the curriculum is to enable the student to do an Energy Use Survey on a residential or light commercial structure. This makes use of information and skills taught throughout the course in technical and, to a lesser extent, in community education areas. The student learns to survey all systems in a structure, calculate energy use and costs, recommend appropriate energy conservation changes and figure payback on investment. An important final step in the survey is reporting to the owner of the structure in such a way that he can make effective use of the information.

Field observations provide students with the opportunity to see professionals engaged in activities directly or peripherally related to energy technology and management.

COST CALCULATIONS 16.5 HOURS

The culmination of the curriculum is the actual preparation for doing energy use surveys and costing energy conservation opportunities. The students use their previously attained knowledge of energy consuming systems to calculate the differences that efficient energy use makes in terms of initial cost, payback periods, and return on investments.

The lecture/demonstration method introduces each component of the module and the students then practice computing costs on actual structures in preparation for conducting a complete energy survey. This module was conducted in congruence with the heating, cooling, and energy survey modules and was evaluated by means of practical application in these modules.

PRE-REQUISITES: Basic Math/Algebra, Introduction to Heating, Introduction to Cooling, Insulation, and Energy Overview

COGNITIVE SKILLS:

Reading and writing level: 8th grade

Math level: Algebra

Dexterity: N.A.

Spatial Orientation: N.A.

COST CALCULATIONS

OBJECTIVES

1) Evaluate energy conservation opportunities using:
   a) Simple payback period
   b) Return on investment
   c) Life cycle costing considering the time-value of money
   d) Savings-to-investment ratio
   e) Discounted payback period
2) Compare energy content and prices of various types of fuels (cost per unit, cost per therm)
3) Calculate total cost per year of heating a building with various types of fuels (both current year and projections to future)
4) Read, interpret, and calculate gas and electric bills

RESOURCES

HANDOUTS
1) Handout #1, "Selling by ROI"
2) Handout #2, "Rates for Local Gas Company"

BOOKS AND REFERENCES
1) ASHRAE Handbook - Systems Volume (1973)

COST CALCULATIONS SYLLABUS

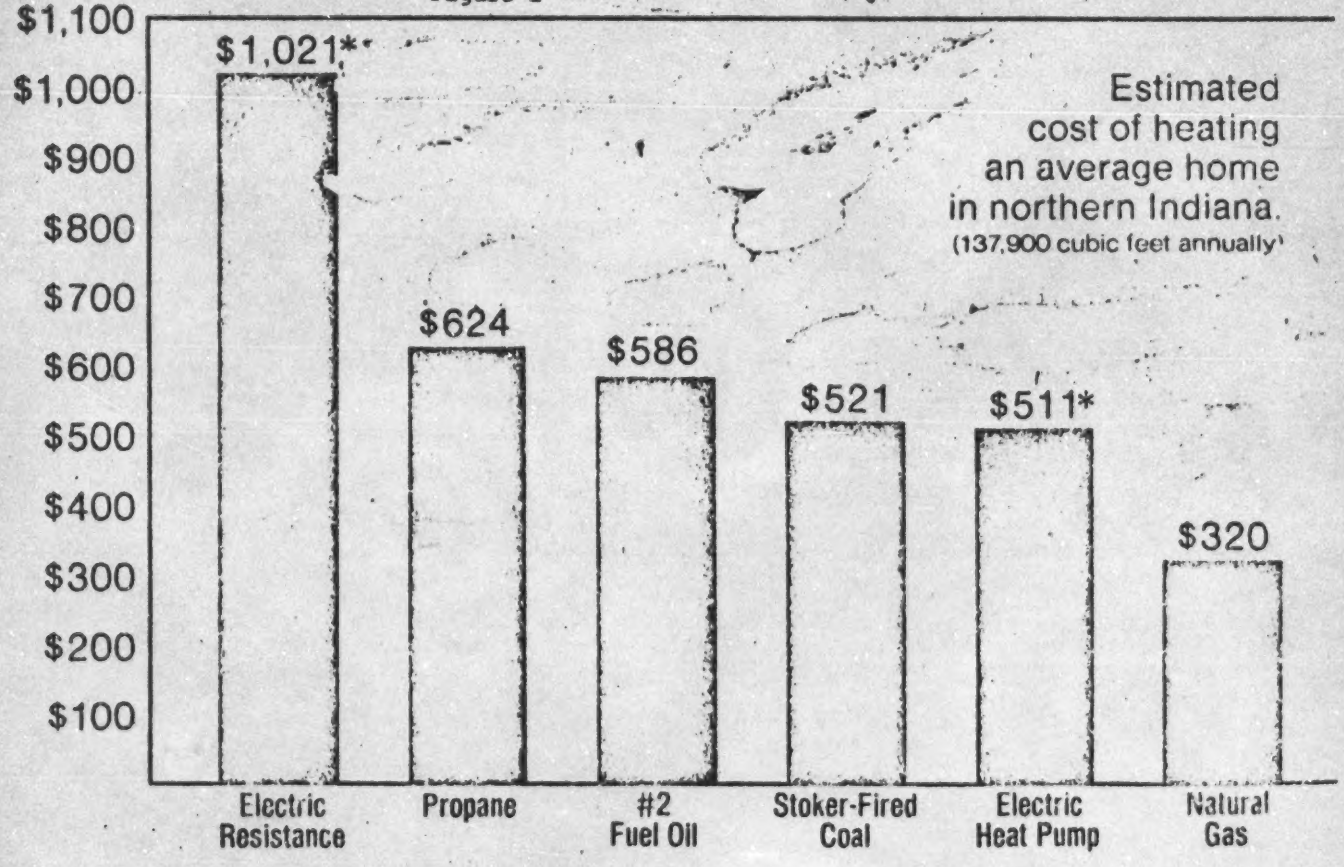
Session #	Hours	Objectives	Topic
1	1.5	1a, 1b, 1c	Economics of conservation; Broad indicators of a profitable investment/payback period (PP); Return on investment (ROI); Life-cycle costing; Cost per unit of fuel; Return on investment (Handout: Selling by (ROI)
2	1.5	2, 3	Review assignment; Fuel types, heating values and efficiencies; Given a house, calculate AES, ADS, AFS, PP, ROI for electricity and any other fuel you choose using Gas Company ad (Fig. 1)
3	2	2, 3	Handout & homework: Determine what cost per full unit NIPSCO used in comparing types of fuel (in-class example)
4	1.5	2, 3, 4	Review assignment; reading, interpreting and calculating gas and electric bills (using local rate tariff handouts)
5	2	1c, 1d, 1e	Economic factors in energy decisions; present time value of money; life-cycle costing; 2 Handouts: "Discounted Payback Nomogram" and "Present Value Discount Factors" (Fig. 2)
6	3	1d	Savings to investment ratio; Handout: Honeywell on "Benefit Cost Ratio" (same as Session 1)
7	2	1c, 1d, 1e	Same as Session 6; present worth factors, discounted payback period
8	3	1c, 3	Calculated example; comparison of life-cycle costs of two room air conditioners; given a sample home, find the RES, AFS, ADS, SPP, ROI, SIR, AROI, DPP (see list of Technical Term Acronyms)

to heating their homes—Oil, Coal, Propane, Electricity and Natural Gas. And they can even do some minimal heating with solar energy.

However, the most efficient, the cleanest and least expensive fuel available for home heating in this area is Natural Gas. Natural Gas is also one of the most convenient and dependable sources. And even though its price is increasing, so is the price of all other heating fuels. Natural Gas will continue to be the least expensive method of heating your home in northern Indiana for some time to come.

Below is a chart showing the cost of heating an average home in northern Indiana with natural gas (using 137,900 cubic feet annually) compared to the cost of heating with other fuels. The figures show the cost of heating only, and do not include the cost for cooking, water heating, clothes drying, and other household uses.

Figure 1



*Electric costs based on NIPSCO electric rates as of January 15, 1979

Naturally you are free to choose any fuel you wish. However, we appreciate your business and want to serve you. But the choice is yours. There is *no* monopoly on heating fuels in northern Indiana.

FIGURE 1

PROJECT EFFECT
COST CALCULATIONS

FIGURE 1

Discounted Payback Nomogram

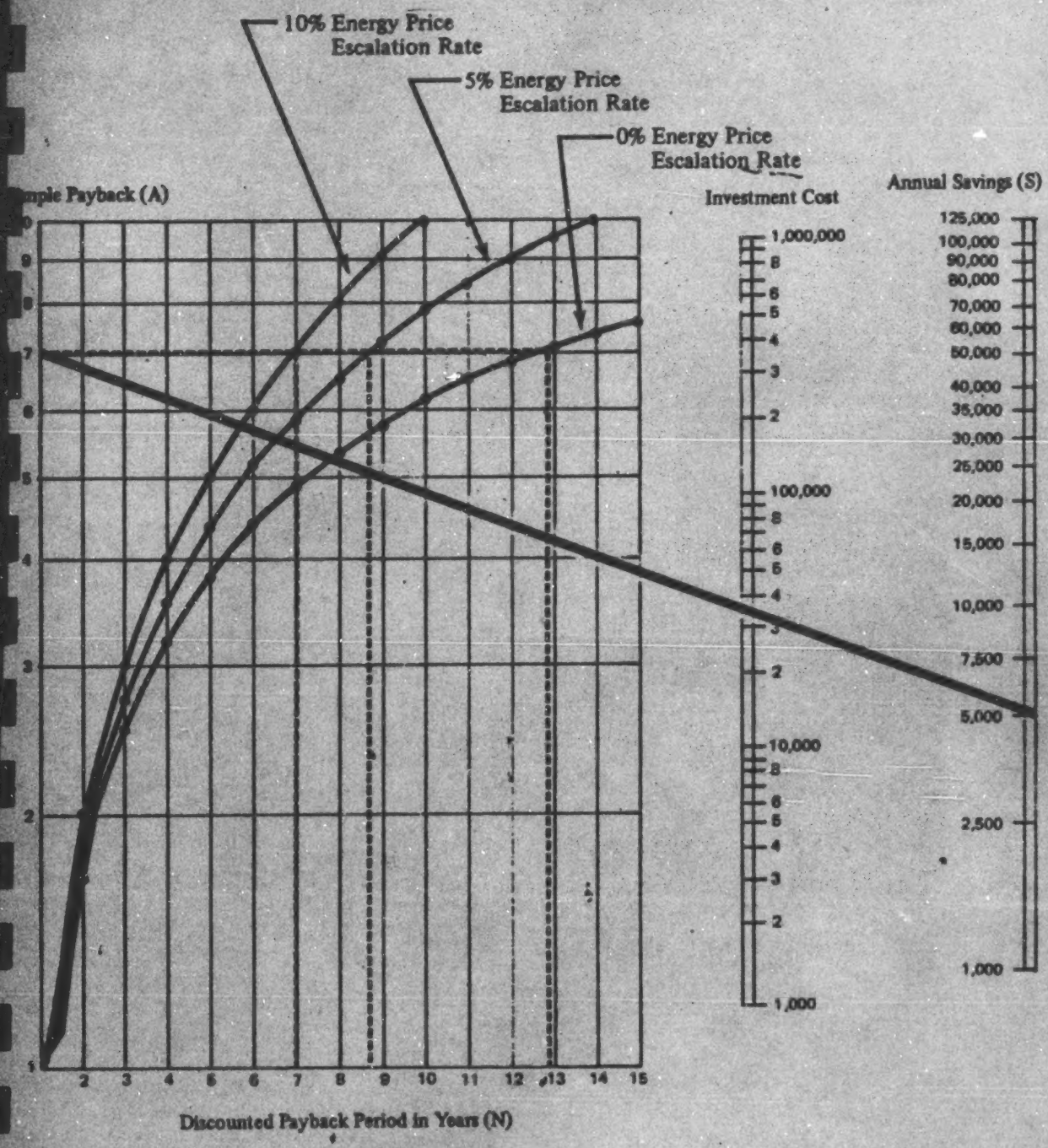


FIGURE 2

PROJECT EFFECT - COST CALCULATIONS

TABLE B-3

Uniform Present Value Discount Factors for Energy Price Escalation Rates from 0% to 10%
(Based Upon a 10% Discount Rate)

	Energy Price Escalation Rates										
Year	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
1	0.9091	0.9182	0.9273	0.9364	0.9455	0.9546	0.9636	0.9727	0.9818	0.9909	1.0000
2	1.7355	1.7612	1.7871	1.8131	1.8393	1.8657	1.8921	1.9188	1.9457	1.9727	2.0000
3	2.4868	2.5353	2.5844	2.6340	2.6844	2.7354	2.7869	2.8391	2.8921	2.9456	3.0000
4	3.1698	3.2460	3.3237	3.4027	3.4834	3.5656	3.6492	3.7344	3.8213	3.9097	4.0000
5	3.7907	3.8986	4.0092	4.1225	4.2388	4.3581	4.4801	4.6053	4.7336	4.8650	5.0000
6	4.3552	4.4978	4.6449	4.7966	4.9531	5.1146	5.2808	5.4524	5.6294	5.8117	6.0000
7	4.8684	5.0480	5.2344	5.4278	5.6284	5.8367	6.0524	6.2765	6.5089	6.7498	7.0000
8	5.3449	5.5521	5.7810	6.0188	6.2669	6.5260	6.7959	7.0780	7.3723	7.6793	8.0000
9	5.7590	6.0159	6.2878	6.5722	6.8705	7.1839	7.5124	7.8577	8.2201	8.6004	9.0000
10	6.1445	6.4417	6.7577	7.0903	7.4411	7.8118	8.2028	8.6161	9.0524	9.5130	10.0000
11	6.4930	6.8328	7.1935	7.5755	7.9807	8.4113	8.8682	9.3539	9.8696	10.4174	11.0000
12	6.8137	7.1919	7.5977	8.0299	8.4909	8.9837	9.5095	10.0717	10.6722	11.3138	12.0000
13	7.1034	7.5216	7.9725	8.4553	8.9733	9.5300	10.1274	10.7698	11.4601	12.2020	13.0000
14	7.3667	7.8243	8.3199	8.8536	9.4293	10.0513	10.7227	11.4487	12.2335	13.0819	14.0000
15	7.6061	8.1022	8.6421	9.2266	9.8604	10.5490	11.2964	12.1092	12.9929	13.9539	15.0000
16	7.8238	8.3574	8.9408	9.5758	10.2680	11.0240	11.8492	12.7516	13.7384	14.8178	16.0000
17	8.0216	8.5918	9.2179	9.9029	10.6535	11.4776	12.3821	13.3767	14.4706	15.6742	17.0000
18	8.2014	8.8069	9.4747	10.2090	11.0177	11.9103	12.8953	13.9844	15.1891	16.5223	18.0000
19	8.3649	9.0044	9.7129	10.4957	11.3622	12.3235	13.3900	14.5757	15.8947	17.3630	19.0000
20	8.5135	9.1857	9.9337	10.7641	11.6878	12.7178	13.8666	15.1507	16.5873	18.1958	20.0000
21	8.6486	9.3512	10.1385	11.0154	11.9957	13.0942	14.3259	15.7101	17.2674	19.0211	21.0000
22	8.7715	9.5042	10.3285	11.2509	12.2870	13.4537	14.7688	16.2546	17.9355	19.8394	22.0000
23	8.8832	9.6446	10.5046	11.4714	12.5623	13.7968	15.1955	16.7841	18.5 3	20.6501	23.0000
24	8.9847	9.7735	10.6679	11.6777	12.8225	14.1241	15.6065	17.2989	19.2349	21.4531	24.0000
25	9.0770	9.8919	10.8193	11.8710	13.0686	14.4367	16.0026	17.7998	19.8670	22.2490	25.0000

NOTE: See Table B-2, "Notes".

FIGURE 2

ENERGY USE SURVEY: PROCEDURES AND TECHNIQUES 46 HOURS

This module makes use of all previous technical background material in leading the student through the actual energy survey. It entails review of all systems and encompasses all the technical skills acquired in earlier modules. Observation and reporting techniques are put to use, as are some community education skills (i.e., when the audit is completed and recommendations made to owners of buildings). This module serves as the transition between the didactic and practicum portions of the curriculum.

Demonstration/practice is used as the fundamental teaching/learning technique. Students audit a building in teams of 5 or 6, each one independently collecting all necessary data while jointly completing a single audit report. Students have an opportunity to practice each component of the audit in preparation for the Practicum.

PRE-REQUISITES: Entire course of study or previous technical training

COGNITIVE SKILLS:

Reading and writing level: 8th grade

Math level: Algebra; graphs and charts

Dexterity: Ability to draw diagrams

Spatial Orientation: Read maps, blueprints, schematics

ENERGY USE SURVEY

OBJECTIVES

1) Distinguish among the types and components of energy audits.

2) Determine building energy use by system.

3) Organize billing audit/load separation.

4) Estimate building energy use by calculation.

5) Verify energy use calculations.

6) Construct bar charts, histograms, pie charts.

7) Evaluate ENERGY CONSERVATION OPPORTUNITIES.

8) Calculate building energy use and potential savings for domestic hot water.

9) Calculate building energy use and potential savings for lighting.

10) Calculate building energy use and potential savings for miscellaneous equipment.

11) Compile a Type A energy audit report.

12) Use audit information in energy management planning.

13) Plan ENERGY CONSERVATION OPPORTUNITIES within the requirements of State and Local building codes.

RESOURCES

BOOKS AND REFERENCES

1. ASHRAE Handbook of Fundamentals - Heating, Refrigerating, Ventilating and Air Conditioning, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., New York, NY, 1972
2. ASHRAE Handbook and Product Directory, 1973 Systems, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., New York, NY, 1973
3. Energy Audit Workbook for Schools, U.S. Department of Energy, September 1978
4. Energy Use and Conservation in the Residential Sector: A Regional Analysis, Stephen H. Dole, June 1975
5. How to Save Energy and Cut Costs in Existing Industrial and Commercial Buildings, An Energy Conservation Manual, Noyes Data Corporation, Park Ridge, New Jersey, 1976
6. IES Lighting Handbook, Fifth Edition, Illuminating Engineering Society, New York, NY, 1972
7. Instructions for Energy Auditors, Volume I, U.S. Department of Energy, Washington, D.C., September 1978
8. Instructions for Energy Auditors, Volume II, U.S. Department of Energy, Washington, D.C., September 1978
9. School Energy Manual, James P. Sneathen and Stanley E. Hecker, III, Michigan School Business Officials Publishers, East Lansing, Michigan, 1978

HANDOUTS

Figure 1: Schematic
Figure 2: Analysis of Existing Systems
Figure 3: Data Organization Form
Figure 4: Fuel Oil Consumption CEC
Figure 5: Climatic Data Summary - South Bend, Indiana
Figure 6: Bar graphs - Heating degree days and Cooling degree days

ENERGY OVERVIEW SYLLABUS

Session #	Hours	Objectives	Topic
1	2	1	Overview of energy auditing handout; Schematic Model (Fig. 1)
2	2	1,2,3,4,8	Residential end use of energy, e.g. National and Regional averages and 1978 Project EFFECT Summary Reports
3	2	2,3,4,7,8,9,10	Domestic hot water: tank losses, piping losses, calculating hot water consumption (AFC-HW), cost (ADC-HW) and potential savings (ADS) from ECO's; Lighting and miscellaneous equipment systems and ECO's
4	3	2,3,4,5	Billing audit/load separation: verification of the audit process, introduction of procedures (phase 2, #II), tabulating monthly consumption and cost data
5	2	2,3,4,5	Class exercise: Converting billing data to monthly form (Fig. 2); Formulas for two billing dates/month and no billing dates for month; billing data organization forms (Fig. 3), load separation procedures (separating weather related consumption from base consumption)
6	3	2,3,4,5	Work session - Billing audit/load separation techniques
7	3	2,3,4,5	Stored fuels billing data (Fig. 4) - The Center for Energy Conservation example; monthly average base load approach to load separation (Fig. 5)
8	2	2,3,4,5,6,7,8, 9,10,11	Organizing the Audit Report (Fig. 1) (1) Load separation phase (2) Verification phase (3) Constructing bar graphs and histograms and pie charts (Fig. 6) (4) Calculating ECO's phase (Energy Conservation Opportunities)

SYLLABUS

ENERGY USE SURVEY

Session #	Hours	Objectives	Topic
9	3		Exam
10	6	12	AEI's and SHI's (Annual Energy Index and Space Heating Index); Work time
11	3	2,3,4,5,6,7, 11,12	Preparation for Nuner School audit; Goal setting; ECO's

SPECIAL FIELD TRIPS

#1	3 hrs.	13	Field trip to South Bend City and St. Joseph County Building; Commissions: St Joseph Building Commissioner Zano Vinnoni, South Bend Building Commissioner Jim Markle
#2	3 hrs.	13	Guest lecturers: Bernie White, President of St. Joseph County Plumbing, Cooling and Heating Contractors Association; Wallace Blicher, President of Total Environment Consultants, Inc.

Project EFFECT

Energy Survey and Cost Calculation

FINAL EXAM

Payback Period and Return on Investment

1) Calculate Simple Payback Period (SPP) and Return on Investment (ROI), Savings to Investment Ratio (SIR) and Discounted Payback Period (DPP) for the following problem: (set up the problem and show your work on the exam paper)

2) Appliance cost $438 with an annual savings of $209.27. An expected life of eight years, the standard investment (i.e., discount rate) is 10% and energy prices rise at the general inflation rate.

Given:
Initial cost of energy-saving improvement = $500.00 with an expected life of seven years.
Annual energy saved = 200 therms.
Standard investment equals 10%/yr. Energy prices rise 5% faster than general inflation rate.

Assumed fuel prices:	Assumed efficiencies:
electricity = $.05/KWH	electricity = 1.3
natural gas = $.25/CCF	natural gas = .7
fuel oil = $.60/gal.	fuel oil = .7

Problem:
For each of three fuels, calculate the following:

1) annual dollar savings,
2) simple payback period,
3) return on investment,
4) savings to investment ratio, and
5) discounted payback period

Determining Monthly Oil Consumption and Cost During a Single Heating Season (July 1976 - June, 1977)

Given:

Fill-up date	gallons	cost
7/1/76	180	71.98
11/16/76	134	54.97
12/21/76	166	69.47
1/17/77	196	84.73
2/14/77	159	74.19
6/30/77	185	82.38

Problem: Fill in the following table (show calculations on back of sheet)

Monthly Distribution of Therms and Cost

Date	Degree Days	Therms	Cost
July, 1976	0		
August, 1976	19		
Sept., 1976	139		
October, 1976	525		
Nov., 1976	949		
Dec., 1976	1302		
Jan., 1977	1628		
Feb., 1977	1063		
March, 1977	640		
April, 1977	327		
May, 1977	85		
June, 1977	68		

Comparative Life Cycle Costs

Calculate E.E.R.'s for the two pieces of refrigeration equipment (set-up your problems and show all work on back of exam paper).

Given:

Unit A: Initial cost - $473
size - 10,000 btu/hr
watts - 1427
cooling output - 53 btu/lb
Compressor input - 9.3 btu/lb

Unit B: Initial cost - $532
size - 10,000 btu/hr
watts - 880
cooling output - 59 btu/lb
compressor input - 7.9 btu/lb

Assuming these two refrigeration units have a seasonal operating time of 850 hours, use Life Cycle Costing Analysis to show which of the two units is cheaper over a fifteen year life expectancy (use average cost over period of $.05/KWH). To calculate present value of operating costs, assume standard investment (discount rate) of 10% and energy costs rise 7% faster than general inflation.

Heat-Loss Calculations

The following pages are taken from "modified" Retrotech.
There are 3 basic functions to perform:

Calculate AEC and DHL for:

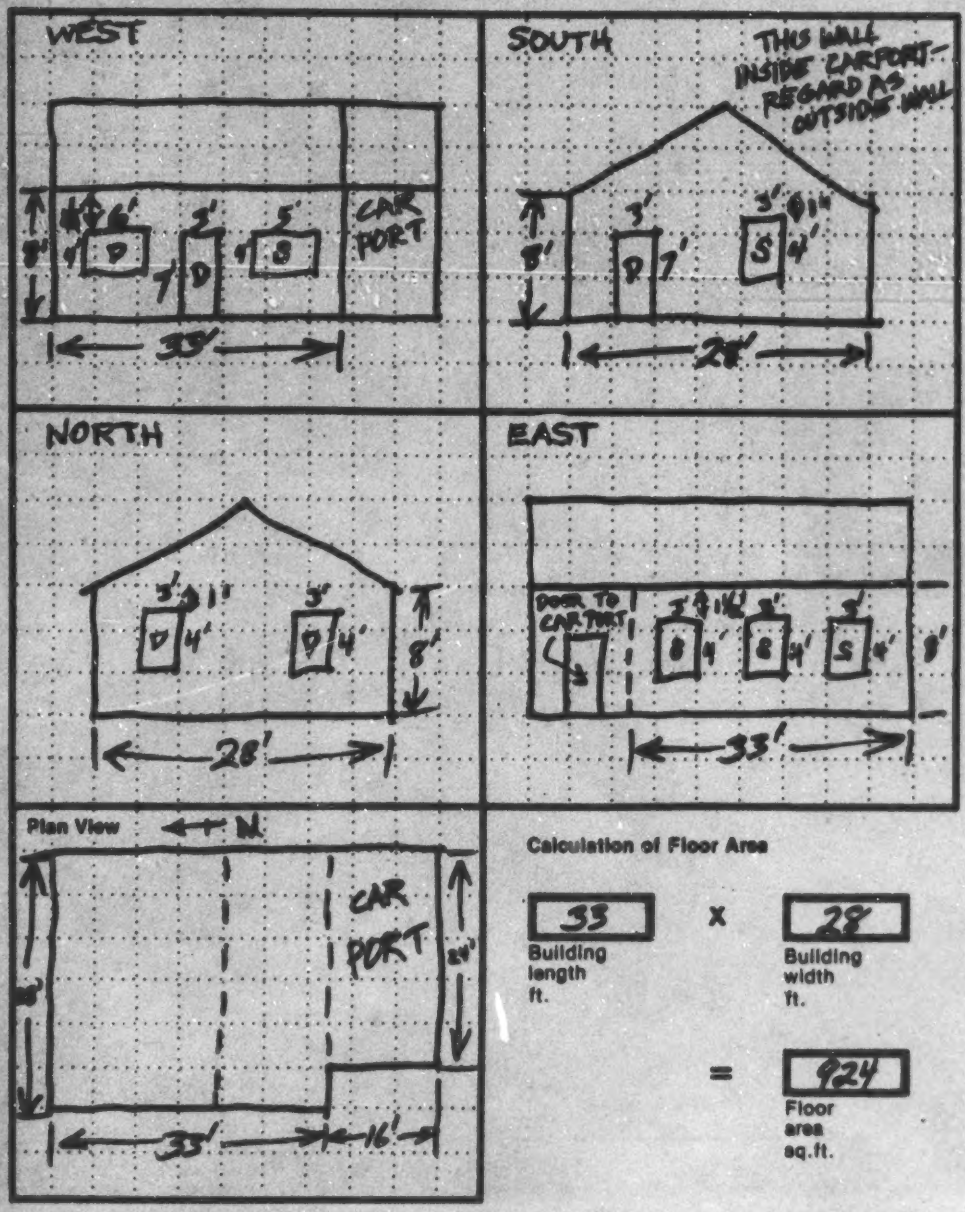
1) infiltration .
2) ceiling, and
3) exterior walls

Home Weatherization
Charts

ProjectRetroTech

3-18

Sketch all views and put dimensions on each part shown, for example, length of walls, width and length of windows, etc. Label all single glass windows S and double glass and doors D. Complete all items in the job book labeled "Fill in at Job Site."



Description of Building

- Dark Roof
- 2 Bedrooms
- Full Basement
- Ducts in Conditioned Space
- Shading:

  W-Draperies

  All others - Roller shades
- 2 ft. Overhang Roof E & W sides
- Naturally vented attic
- Oil Fired Warm-Air Furance (Eff = 0.7)
- Air Conditioner (EER = 7)

Calculation of Floor Area

35	x	28	=	924
Building length ft.		Building width ft.		Floor area sq.ft.

These grids are provided as guides for lines. Drawings need not be done to scale.

Heat Loss by Infiltration

On pages 4-9, calculate the heat loss by infiltration and by conduction through the separate parts of the building; enter the results in the table at the bottom of each page and in the summary table on page 10.

House Draft Index: Opposite each of the four component parts of a building in the table below, place a check mark in the circle adjacent to the features which best describe the condition of the building.

Building Component	Air change per hour (1) .5	Air change per hour (2) 1	Air change per hour (3) 2
Cellar or Crawl Space	Tight, no cracks, caulked sills, sealed cellar windows, no grade entrance leaks Plywood floor, no trap door leaks, no leaks around water, sewer, and electrical openings ✓	Some foundation cracks, loose cellar windows, grade entrance not tight Tongue-and-groove board floor, reasonable fit on trap doors, around pipes ○	Major foundation cracks, poor seal around grade entrance Board floor, loose fit around pipes ○
Windows	Storm windows with good fit ✓	No storm windows, good fit on regular windows ○	No storm windows, loose fit on regular windows ○
Doors	Good fit on storm doors ✓	Loose storm doors, poor fit on inside door ○	No storm doors, loose fit on inside door ○
Walls	Caulked windows and doors, building paper used under siding ✓	Caulking in poor repair, building needs paint ○	No indication of building paper, evident cracks around door and window frame ○

FILL IN AT JOB SITE

Multiply the number of check marks in the first column by .5 the second column by 1, and the third column by 2. The Draft Index will be the sum of these products, divided by 4.

[ ] Floor area sq.ft. x [ ] Height to ceiling (to upstairs ceiling in two-story house) ft. = [ ] Volume of air in building cu.ft.

[ ] Volume of air in building x [ ] Draft index x [1.54] District heating factor x .018 = [ ] Heating units required

Potential Savings by Reducing Infiltration

It should be possible to reduce the draft index for a building to .5 (that is, reduce the number of air changes to ½ per hour). If the draft index for this building were improved to .5 the infiltration loss would be:

[ ] Volume (from above) x [.5] Draft index x [1.54] District heating factor x .018 = [ ] Potential heating units

Subtract the potential heating units from those now required and enter here →

Type of Heat Loss	Heating Units Required	Potential Heating Savings	Proposed Changes to Structure
Infiltration			none

Project RetroTech

Home Weatherization
Job Book

3-20

Heat Losses by Conduction Through Ceilings

Area of Ceiling
(Take area of upstairs ceiling in a two-story house)

Ceiling area will normally be the same as floor area (from building description sheet)

16" Distance between joists/rafters:

Material	Thickness (inches)	R Value
Inside surface	–	0.61
64 Sum Bd.	3/8	0.32
Fiber Bd.	2	7.4
Inside surface	–	0.61
— OR —		
Outside surface (0.17)	–	
	Total R value	

FILL IN AT JOB SITE

[ ] Ceiling area sq.ft. x [1.54] District heating factor + [ ] Total R value = [ ] Heating units required

Potential Savings by Insulation of Ceilings

A well-insulated ceiling (with 6 inches of insulation) should have an R value of 20. If the R value were 20 for this building, the ceiling heat loss would be:

[ ] Ceiling area sq.ft. x [1.54] District heating factor + [20] Total R value = [ ] Potential heating units

Subtract the potential heating units from those now required and enter here →

Type of Heat Loss	Heating Units Required	Potential Heating Savings	Proposed Changes to Structure
Conduction Through Ceilings			add 6" cellulose

Home Weatherization
Job Book

ProjectRetroTech

3-21

Heat Losses by Conduction Through Walls

R Value of Outside Walls

List below all materials in walls, starting from inside and including air spaces within the wall. Insert R value for each component from Table 1.

Material	Thickness (inches)	R Value
Interior surface	—	0.68
plaster + lath	3/4"	.42
air space	3½"	.91
ship-lap	1/2"	1.05
alum. siding	-	.79
Outside surface	—	.17
	Total R value	

FILL IN AT JOB SITE

[ ] Total perimeter of outside wall ft. X [ ] Total height of outside wall ft. = [ ] Gross wall area sq.ft

[ ] Gross wall area sq.ft − [ ] Total area of all windows and doors (from previous two pages) sq.ft. = [ ] Net wall area sq.ft.

[ ] Net wall area X [1.54] District heating factor + [ ] Total R Value = [ ] Heating units required

Potential Savings by Insulation

Well-insulated walls should have an R value of 18. If this were so for this building, the wall heat loss would be:

[ ] Net wall area (from box above) X [1.54] District heating factor + [15] R value = [ ] Potential heating units

Subtract the potential heating units from those now required and enter here →

66

Type of Heat Loss	Heating Units Required	Potential Heating Savings	Proposed Changes to Structure
Conduction Through Walls			add 3½" cellulose

Heat Gain Calculations

Assuming the following design conditions, determine:

a) equivalent temperature differentials (E.T.D.'s) for walls, ceilings, and floors

b) heat gain through north and west windows

c) heat gain through north and west walls

d) heat gain due to infiltration

e) heat gain through the ceiling

Given:

1) note description of building at beginning of this section

2) note R values developed for heat loss calculations

3) design temperatures -
   a) outdoor dry bulb = 90°F
   b) indoor dry bulb = 75°F
   c) outdoor temperature range = moderate
   d) indoor temperature swing = 3°F

3-23

Analyzing Energy Conservation Opportunities

For the building described on Page 5 ff., calculate the simple payback period on adding 3½" of cellulose to walls (assume R-3.7 and cost of $.35/sq ft installed for cellulose).

Estimating Annual Hot Water Usage

Given:
A family of 5, gas fired non-circulating hot water system set at 150°F. Usage consists of 35 showers, 8 loads of laundry and 10 loads of dishes per week. The family leaves on vacation for 2 weeks every summer.

1) Find:
AHW (gals/yr), AEC-HW, AFC-HW, ADC-HW if gas costs $0.25/ccf

2) AES, AFS, ADS-HW, SPP & ROI for installing flow restrictors on the two showers (reducing flow by half). The restrictors cost $5 each.

Billing Audit and Load Separation

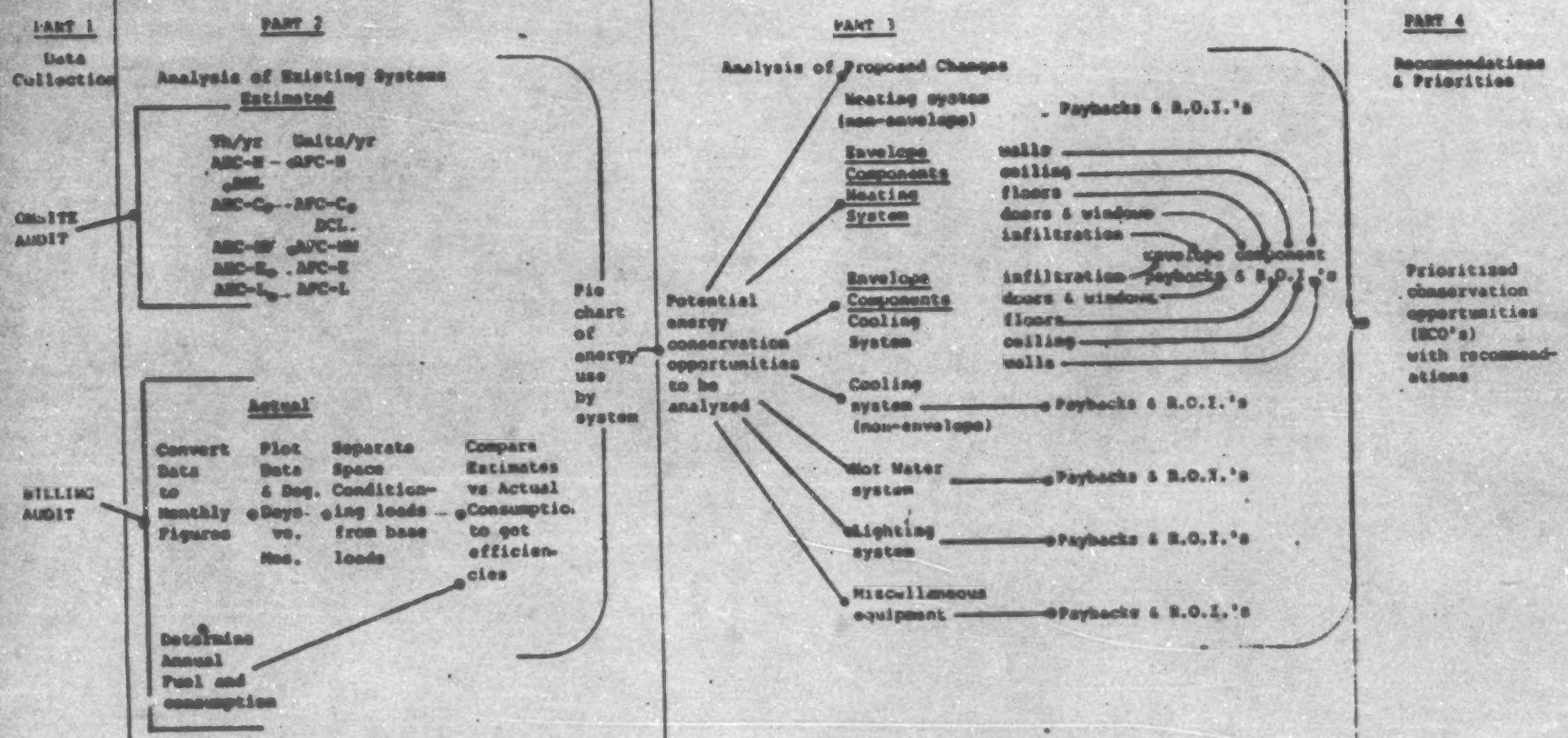
Billing date	(ccf) Consumption	Cost	HDD	(ccf) En (consumption)
7/12/76	48	$ 11.70	0	42.34
8/10/76	38	9.58	19	-----
9/10/76	35	9.06	139	49.17
10/11/76	60	13.95	525	125.14
11/11/76	162	30.18	949	194.32
12/13/76	216	40.46	1302	259.57
1/13/77	315	60.57	1628	------
2/11/77	268	53.57	1063	206.27
3/11/77	153	33.01	640	137.43
4/12/77	133	30.04	327	94.31
5/11/77	69	17.65	85	58.87
6/10.77	48	13.54	68	50.12
	1545	323.31	6745	-----

Show all your work on the back of this page.

1) Compute the En's for the two outstanding months from the above billing data.

2) Compute the annual base load consumption for the above twelve month period.

Energy Survey and Cost Calculation
Figure 1: Schematic Diagram



I. Billing Audit - Actual Energy Consumption

A. Convert and tabulate billing data (consumption and cost figures) to monthly form.

1. For continuously supplied fuel (e.g., piped natural gas, electricity, purchased steam, etc.) use the following formula:

$$E_n = \frac{C_n \times B_n}{(B_n + N_{n-1} - B_{n-1})} * + \frac{C_{n+1} \times (N_n - B_n)}{(B_{n+1} + N_n - B_n)} *$$

Where:
E_n = fuel consumption (or cost) for desired month n
n = desired month
$n-1$ = previous month
$n+1$ = following month
N_n = number of days in month n
N_{n-1} = number of days in month n-1
B_n = Billing (meter reading) date for month n
B_{n-1} = Billing (meter reading) date for month n-1
B_{n+1} = Billing (meter reading) date for month n+1
C_n = Fuel consumption (or cost) for billing period between dates B_{n-1} and B_n (or consumption (or cost) for first billing period containing part of E_n)
C_{n+1} = fuel consumption (or cost) for billing period between dates B_n and B_{n+1} (or consumption (or cost) for second billing period containing part of E_n)

*Note: $(B_n + N_n - B_{n-1})$ = number of days in billing period for C_n

$(B_{n+1} + N_n - B_n)$ = number of days in billing period for C_{n+1}

2. For intermittently supplied, stored fuels (e.g., oil, coal, wood, LP gas, etc):
   a. Sum up total of all fuel deliveries (and costs) over the specified consumption period. (Be sure to subtract the first delivery in the period since this figure represents fuel used before the tank was filled.)
   b. Divide by total of monthly heating degree days in the same period to obtain appropriate fuel units consumed (or cost) per degree-day (e.g., gals/degree-day, $/degree day)
   c. Then multiply the answer(s) from b. by the number of heating degree days per month to obtain appropriate fuel units (or cost) per month (e.g., gals/month, $/month)

3. Divide monthly fuel consumption by the appropriate fuel factor (FF, from I.A.2. above) to obtain monthly energy consumptions in Therms/month.

Figure 2: Analysis of Existing Systems (cont.)

I. Billing Audit - Actual Energy Consumption (cont.)

B. Make a graph for each fuel used showing:
1. Monthly fuel consumption vs. months.
2. Monthly costs vs. months.
3. Heating degree days (base 65°F) vs. months (for the fuel used by the heating system).
4. Cooling degree-days (base 65°) vs. months (for the fuel used by the cooling system, usually electricity).

C. Sum up monthly totals in A. above for each complete year of data available for each fuel used to obtain actual values for all systems:
1. Total annual fuel consumption, in appropriate fuel units per year.
2. Total annual energy consumption, in Therms/year.
3. Total annual costs, in dollars/year.

D. Separate space conditioning inputs from base loads (energy used for purposes other than space heating or cooling) for each fuel (± 10% accuracy)
1. a. For fuel used by heating systems:
Take the monthly fuel consumption figures for the 5 months of lowest space heating consumption (i.e., May thru September) from II.A. above.
b. For fuel used by cooling system (usually electricity):
Take the monthly fuel consumption figures (from II.A. above) for the 5 months of lowest space cooling consumption (i.e. Nov. thru March.

2. Exclude the highest and lowest of the five monthly figures

3. Sum the remaining three monthly figures and divide by 3 to obtain average monthly base loads for each fuel (Note: If more than one set of May thru Sept. or Nov. thru March figures are available from past bills calculate as many base load figures as possible from the figures available and then use the average of those. The more figures available, the greater the accuracy of the calculation).

4. Multiply the monthly average base loads by 12 months/yr. to obtain average annual base loads, in appropriate fuel units per year for each fuel used.

5. Subtract the base load from II.D.4 from the total fuel consumption in II.C.1 for the appropriate fuel to obtain:
a. Annual heating system fuel consumption, in appropriate units/yr.
b. Annual cooling system fuel (electricity) consumtion, Kwh/yr.

6. To correct for the effects of unusually warm or cold weather, multiply the answers from II.D.5.a and b. by:

a. No. of heating degree days (base 65°F) ÷ 6440 for heating system
b. No. of cooling degree days (base 65°F) ÷ 715 for cooling system

These answers will represent the heating or cooling system's consumption during a "normal" (average) year.

Energy Survey .

FIGURE 3: DATA ORGANIZATION FORM

BILLING AUDIT

MONTH	CALENDAR MONTH	CALENDAR YEAR	DAYS/ MONTH	BILLING MONTH	BILLING DATE	BILLING YEAR	BILLING CONSUMPTION	BILLING COST	HDD HDD	CDD CDD
1	6		30							
2	7		31							
3	8		31							
4	9		30							
5	10		31							
6	11		30							
7	12		31							
8	1		31							
9	2									
10	3		31							
11	4		30							
12	5		31							
13	6		31							
14	7		31							

AUDIT SITE _____ FUEL TYPE _____

AUDIT YEARS _____

75

76

Figure 4: FUEL OIL CONSUMPTION CsC

CEC 913 20th St.

3-30

Year	Mo.	Deliveries Gal.	Cost		D.D./Mo.	Gal./Mo.	Cost/Mo.
	6						
	7						
	8						
	9	149,5	57.41	9/9/75			
	10						
	11						
1975-	12	146	58.40	12/2/75			
1976	1	179	71.60	1/6/76			
	2	155.5	62.20	1/30/76			
	3	208	85.07	3/15/76			
	4						
	5						
	6						
	7						
	8						
	9	116	46.28	9/7/76			
	10						
1976-	11	225	94.27	11/20/76			
1977	12	242	106.24	12/21/76			
	1	190	85.31	1/10/77			
	2	177	81.24	2/1/77			
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11	258	118.42	11/28/77			
1977-	12	205	100.25	12/27/77			
1978	1	218	106.60	1/23/78			
	2	169	80.95	2/10/78			
	3	232	113.45	3/8/78			
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11	238.6	120.24	11/22/78			
1978-	12						
1979	1	219.1	115.90	1/26/79			
	2						
	3	175.6	101.15	3/13/79			
	4						

Energy Survey
Figure 5: Climatic Data Summary - South Bend, Indiana

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
01938	22.6	32.0	44.4	49.8	60.1	67.9	72.9	74.6	64.8	57.9	40.4	29.2	51.2
01939	31.6	29.6	38.0	49.0	62.1	71.3	72.1	70.4	67.2	52.7	36.8	31.2	51.2
1940	24.9	26.8	36.2	46.2	59.8	68.9	74.2	72.3	62.2	54.7	37.0	32.9	49.7
1941	26.4	23.3	31.8	39.7	62.1	65.9	72.6	72.4	67.9	54.4	41.9	33.4	51.0
1942	26.2	29.4	36.1	52.2	60.4	69.4	72.3	70.8	61.2	51.6	41.1	33.6	49.8
1943	25.8	26.9	32.8	43.2	56.4	71.8	73.2	71.7	59.8	50.6	39.4	26.8	47.6
1944	30.6	28.3	36.4	44.7	63.6	71.9	73.9	73.0	64.0	51.8	41.7	33.9	49.6
1945	19.8	28.9	47.2	46.7	52.4	64.3	70.2	70.2	63.2	49.8	40.8	31.4	47.6
1946	28.6	27.6	41.4	48.0	58.6	67.4	73.6	67.4	65.8	52.2	43.4	32.2	51.0
1947	27.2	29.4	39.8	48.0	62.6	68.2	69.8	72.8	65.8	54.8	34.8	28.7	48.8
1948	25.7	24.8	33.3	51.4	56.7	66.4	72.2	71.4	66.4	49.3	43.8	29.4	48.8
1949	28.8	28.7	34.3	46.1	59.8	72.3	74.8	72.8	58.4	54.8	39.3	32.6	50.4
1950	31.2	29.6	31.4	41.8	59.9	66.8	69.2	69.2	63.8	57.8	39.6	29.9	47.9
1951	23.8	27.3	39..	49.7	60.1	66.1	70.9	67.6	65.7	53.9	37.8	26.3	47.6
1952	27.7	31.1	39.1	48.8	56.1	72.1	74.2	69.9	63.8	47.1	41.2	31.9	49.9
1953	28.9	31.8	37.6	46.6	60.3	72.9	74.6	72.6	67.4	49.6	40.8	31.4	51.3
1954	28.6	24.8	38.3	51.8	64.5	71.3	72.5	69.8	66.2	54.8	40.7	29.7	50.3
1955	23.9	29.8	35.9	50.8	60.1	70.3	73.7	74.4	64.2	57.6	39.9	35.1	50.1
1956	23.1	27.3	34.7	48.6	58.8	71.1	71.9	71.6	61.8	58.4	39.8	33.6	49.9
1957	18.4	31.8	36.8	48.8	58.6	68.9	73.7	70.8	61.5	49.6	40.8	32.2	49.3
1958	24.7	30.9	39.6	49.6	56.9	69.8	71.2	70.5	65.2	54.9	42.1	29.6	49.9
1959	18.6	29.6	39.8	47.7	63.6	69.9	71.3	74.6	67.4	51.1	39.8	36.6	49.7
1960	27.5	29.1	29.7	50.8	56.9	68.7	70.6	72.3	66.1	53.8	41.8	24.8	48.6
1961	21.9	30.6	38.8	48.3	54.8	67.3	71.7	71.8	68.2	54.1	48.1	28.7	49.8
1962	18.1	24.1	34.8	47.8	60.3	69.3	69.5	71.3	61.8	54.4	40.1	34.8	48.2
01963	23.3	18.8	38.3	49.2	56.6	69.9	71.7	67.6	64.6	61.8	43.1	39.4	47.9
1964	20.5	27.3	33.6	52.4	63.3	71.1	70.8	68.8	63.8	48.8	43.2	27.3	48.2
1965	24.7	27.8	28.7	46.9	64.2	67.3	69.9	68.1	68.7	51.6	40.6	36.4	49.1
1966	20.3	29.1	39.1	43.8	62.2	68.8	72.6	67.2	62.3	51.7	42.8	29.9	48.4
1967	29.8	21.1	36.9	48.9	54.3	70.6	69.4	67.6	63.3	51.7	36.6	30.3	48.2
1968	22.5	23.3	39.5	50.8	59.2	68.9	71.8	71.8	64.8	55.8	40.7	27.8	48.8
1969	22.8	27.9	32.9	50.3	59.8	64.9	73.1	73.4	64.8	54.4	37.2	27.9	48.4
1970	20.4	29.7	34.9	48.8	61.8	67.8	72.6	70.4	64.8	54.4	39.4	28.4	48.8
1971	28.8	28.6	33.9	46.8	56.3	73.9	69.8	68.4	67.2	48.6	40.8	26.8	48.1
1972	25.6	26.3	39.6	49.4	60.8	69.5	71.4	69.6	62.8	49.7	39.1	28.8	47.8
1973	20.9	30.8	44.7	50.1	64.1	71.3	74.4	74.3	67.8	58.3	40.4	29.2	52.7
1974	27.9	28.1	39.8	51.7	57.3	68.8	73.8	71.9	62.8	52.8	42.4	32.9	50.7
1975	30.8	27.8	34.4	49.6	63.2	70.5	71.9	73.4	66.1	59.4	40.1	32.7	51.8
1976	21.6	25.3	43.4	53.7	57.8	70.9	73.1	69.8	61.3	47.9	39.2	33.8	49.8
1977	12.3	20.8	44.1	53.4	68.7	67.7	70.3	69.6	69.3	58.3	41.6	33.9	50.4
RECORD													
mean	26.5	29.0	38.3	49.1	59.1	68.8	72.2	71.4	64.6	53.2	40.8	28.6	49.8
max	33.8	34.6	49.1	58.2	70.7	79.0	84.3	82.4	73.6	63.6	47.8	35.3	59.8
min	16.9	16.9	27.4	37.2	48.0	57.9	62.1	60.3	55.8	43.3	33.7	21.8	39.9
1978	18.5	14.8	31.2	48.1	59.5	69.2	71.7	71.9	68.5	54.9	42.9	29.5	48.2
1979	17.9												

Heating Degree Days

SOUTH BEND, IN

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1947-48	0	7	134	489	762	977	1241	1231	929	458	212	98	6814
1948-49	1	0	121	525	669	1170	1428	1099	897	312	158	36	6644
1949-50	1	0	97	630	903	931	1160	1150	1172	441	299	38	6782
1950-51	0	0	51	371	690	1239	1332	961	806	660	362	32	6826
1951-52	7	3	79	362	749	1178	1413	1140	935	530	230	29	6860
1952-53	10	3	181	568	761	1284	1392	1313	813	478	278	38	7279
01953-54	0	15	98	504	892	1407	1190	1065	898	497	119	58	6946
1954-55	3	4	139	493	848	1197	1244	1050	1138	533	95	36	6990
1955-56	3	16	121	411	727	879	1377	1025	796	584	402	47	6431
1956-57	4	21	138	412	858	1070	1100	1228	880	474	357	8	6350
1957-58	2	30	137	429	841	1004	1317	1253	770	444	311	25	6671
1958-59	11	27	69	372	724	1171	1316	1054	898	435	220	103	6470
1959-60	0	0	118	421	826	1139	1485	1094	1087	497	181	48	6967
1960-61	18	11	93	327	766	1044	1367	1012	959	582	280	7	6488
1961-62	14	13	86	371	710	892	1200	1110	973	582	197	109	6127
1962-63	23	38	118	568	801	1119	1080	977	991	644	268	8	6887
1963-64	0	0	98	439	811	1182	1142	1026	988	693	290	51	6660
1964-65	0	3	144	378	872	985	1077	1039	944	634	196	37	6649
1965-66	11	1	72	300	803	992	1226	930	681	407	253	7	6668
1966-67	1	0	76	323	849	1202	1218	1063	805	327	93	68	6763
1967-68	3	15	93	445	849	1284	1428	1001	1041	480	239	41	7028
68-69	5	4	57	392	654	1058	1363	1310	945				

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	0	59	109	257	236	78	31	0	0	737
1970	0	0	0	19	65	136	240	189	93	9	0	0	751
1971	0	0	0	3	17	88	183	115	138	34	0	0	569
1972	0	0	0	0	47	74	226	160	96	0	0	0	583
1973	0	0	0	7	1	226	299	268	184	85	0	0	930
1974	0	0	0	0	17	114	221	223	98	33	0	0	729
1975	0	0	0	0	0	66	205	232	274	52	1	0	829
1976	0	0	0	27	13	102	249	190	96	6	0	0	683
1977	0	0	0	47	206	137	293	172	74	0	2	0	994
1978	0	0	0	0	70	173	218	227	173	0	1	0	846
1979	0	0	0										

Precipitation

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
01938	1.80	3.18	3.98	3.99	3.84	3.17	4.29	2.08	3.98	0.78	1.84	1.91	35.10
01939	2.76	1.44	3.05	4.84	0.94	6.68	3.48	4.88	0.58	3.87	2.01	1.03	37.30
1940	1.33	1.27	2.11	2.84	4.78	9.01	1.08	4.78	1.93	2.88	2.88	2.88	34.37
1941	1.72	0.99	1.68	3.84	2.03	2.68	2.47	1.78	2.03	9.24	2.99	1.37	34.81
1942	2.31	1.98	2.52	2.08	3.11	1.97	3.92	4.28	2.36	2.16	2.88	2.57	34.00
1943	1.04	1.45	2.00	3.37	6.28	2.89	3.18	3.28	3.28	2.07	0.98	0.98	40.09
1944	0.98	1.26	0.96	4.26	4.26	2.38	1.38	2.38	0.96	2.18	1.26	1.26	31.21
1945	0.44	1.00	2.88	4.37	2.59	3.26	6.28	2.78	0.96	1.69	2.87	1.11	35.00
1946	2.88	2.09	3.09	1.01	4.84	4.09	8.65	1.36	2.16	2.88	2.97	3.08	31.41
1947	2.04	0.87	2.16	5.06	3.44	2.08	2.33	7.08	0.98	2.26	1.93	1.93	41.78
1948	1.94	2.33	4.79	1.98	3.20	3.99	2.34	1.14	3.02	0.91	2.21	3.26	33.18
1949	2.94	2.09	2.18	1.23	3.24	4.33	3.68	3.96	3.05	2.04	2.01	3.01	37.82
1950	4.02	3.78	3.47	3.32	3.41	8.20	6.15	8.38	3.07	0.42	4.21	2.97	46.90
1951	2.13	1.33	1.05	4.78	3.03	4.07	3.01	2.05	6.46	4.78	4.08	3.09	44.06
1952	2.08	0.88	2.98	2.84	4.89	2.85	3.82	3.47	0.71	1.31	2.27	1.97	28.79
1953	2.39	1.28	2.52	3.97	2.75	3.42	1.86	3.96	1.96	1.04	1.36	1.36	27.30
1954	1.83	4.01	4.05	3.35	2.07	3.45	2.16	1.68	0.78	2.21	2.00	1.36	40.71
1955	2.38	1.93	2.34	2.38	2.17	4.13	6.01	2.98	0.91	2.61	0.79	1.38	39.01
1956	1.88	2.07	1.98	4.47	4.75	1.41	1.98	3.08	0.82	0.87	2.04	1.43	33.88
1957	2.32	1.32	2.91	4.05	2.27	2.22	2.59	2.72	1.96	2.85	2.82	4.47	40.00
1958	1.46	1.99	0.56	2.12	1.76	3.58	7.16	3.82	2.46	1.16	2.82	1.18	29.99
1959	2.38	2.08	3.98	4.27	2.28	1.48	6.16	0.93	2.08	2.82	1.88	1.88	38.47
1960	4.88	4.93	2.18	3.76	1.85	5.79	1.81	3.26	3.48	2.04	1.06	0.87	39.94
1961	0.98	1.88	3.80	4.98	1.18	3.66	3.78	2.88	3.78	1.88	1.48	2.08	33.78
1962	2.38	1.76	1.88	2.36	2.18	5.88	4.87	3.48	1.28	4.36	1.33	2.66	34.21
1963	1.28	1.18	3.88	2.62	2.68	1.88	5.18	1.18	1.28	2.88	1.98	1.98	29.18
1964	1.87	1.88	3.88	3.28	4.88	4.48	3.48	3.38	0.88	2.38	2.36	2.38	36.12
1965	4.76	2.78	3.28	4.87	1.87	2.28	2.28	5.68	3.38	2.38	1.88	3.38	42.48
1966	1.38	1.78	2.88	3.78	3.88	1.88	4.88	3.68	1.18	1.38	4.88	4.78	39.88
1967	3.38	2.28	1.78	4.88	2.87	3.48	2.18	2.38	3.88	2.38	3.84	4.38	39.87
1968	2.88	3.28	1.28	2.88	5.88	2.88	3.18	4.38	1.48	3.68	3.68	3.68	39.32
1969	3.88	0.98	1.88	3.88	4.28	5.17	4.88	0.88	1.82	4.78	2.28	1.88	35.88
1970	1.88	0.78	2.88	5.88	3.28	3.82	4.18	3.37	3.37	3.88	3.88	1.78	39.98
1971	1.38	2.18	2.18	0.38	1.88	1.18	4.18	2.88	3.18	2.88	1.88	4.38	29.88
1972	1.82	1.38	3.68	3.28	3.88	2.78	4.38	3.88	1.87	3.78	2.88	4.78	33.28
1973	1.88	1.82	3.88	3.88	5.81	4.88	3.88	2.18	3.88	4.88	3.88	3.88	42.88
1974	2.38	2.38	2.81	4.17	4.82	4.88	1.17	3.88	2.88	2.88	2.88	3.88	37.31
1975	4.38	3.38	2.88	0.82	2.88	3.44	2.88	7.38	1.38	1.31	4.78	3.72	43.48
1976	2.21	3.38	7.84	3.38	0.87	6.68	3.86	2.44	3.34	2.28	3.28	2.88	46.28
1977	1.84	1.27	7.85	2.78	1.92	2.76	2.88	6.85	0.81	3.88	4.27	3.88	49.88
RECORD													
MEAN	2.31	1.82	2.99	3.61	3.38	3.87	3.29	3.39	3.34	2.94	2.74	2.39	38.84
1978	4.03	0.16	2.37	4.38	3.35	3.79	5.21	3.80	3.47	3.92	2.79	4.48	42.04

Snowfall

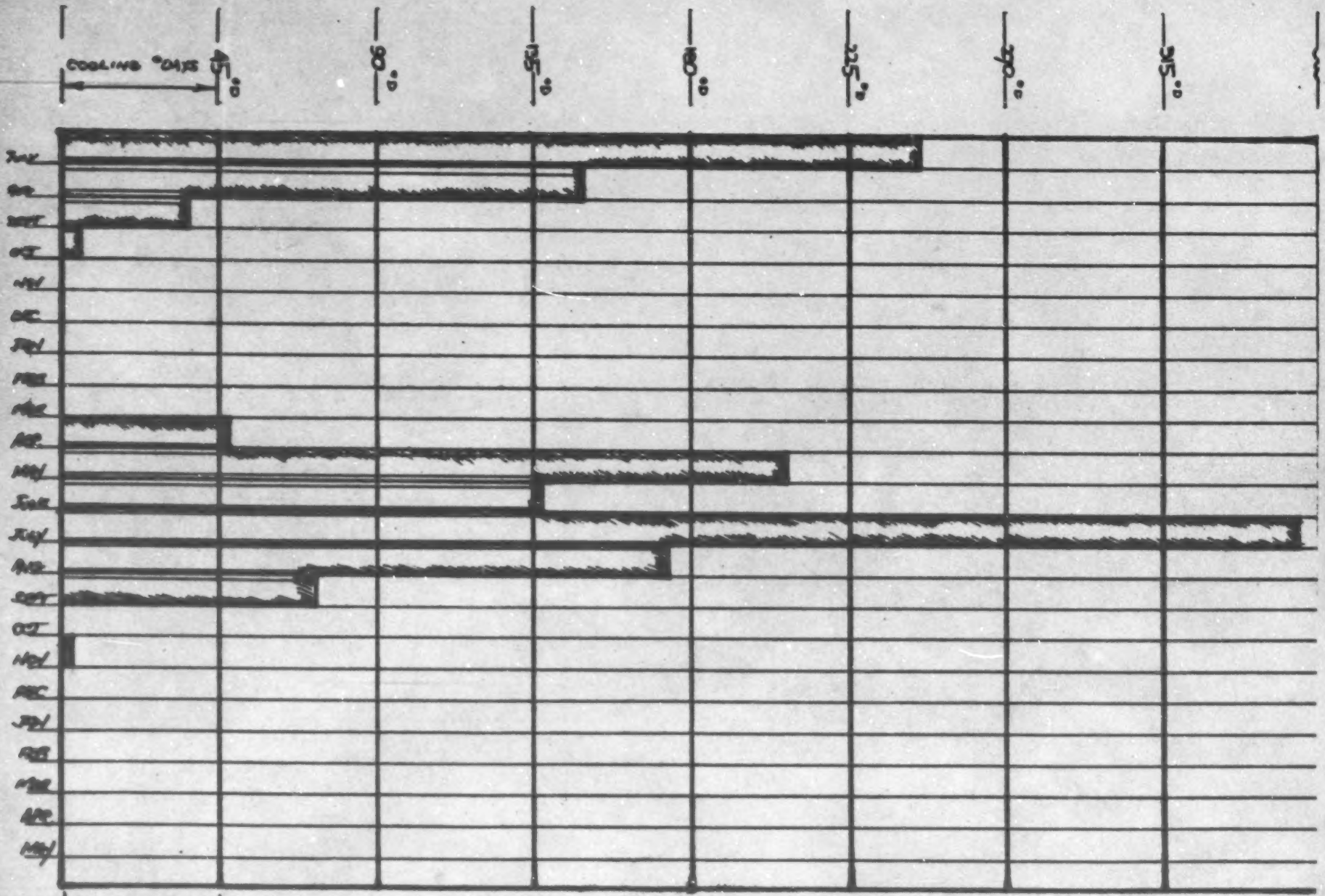
Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1938-39	0.0	0.0	0.0	0.0	2.3	6.3	20.0	9.0	2.3	2.0	0.0	0.0	40.0
01939-40	0.0	0.0	0.0	0.0	2.2	6.1	19.0	10.0	10.7	0.5	0.0	0.0	50.0
1940-41	0.0	0.0	0.0	0.0	5.3	9.7	11.2	10.9	0.3	T	0.0	0.0	40.0
1941-42	0.0	0.0	0.0	0.0	3.0	2.3	9.0	14.0	4.3	0.0	0.0	0.0	31.3
1942-43	0.0	0.0	0.2	T	0.0	18.9	23.0	16.2	6.4	0.4	0.0	0.0	75.0
1943-44	0.0	0.0	0.0	T	3.3	11.9	1.0	1.0	12.0	1.7	0.0	0.0	30.0
1944-45	0.0	0.0	0.0	0.0	3.2	10.7	11.5	2.0	2.0	T	T	0.0	37.0
1945-46	0.0	0.0	0.0	0.0	5.0	15.7	2.0	11.7	0.2	0.0	0.0	0.0	41.1
1946-47	0.0	0.0	0.0	0.0	T	10.1	9.8	12.2	7.0	0.5	T	0.0	40.1
1947-48	0.0	0.0	0.0	0.0	0.0	11.0	10.6	4.0	3.0	T	0.0	0.0	28.0
1948-49	0.0	0.0	0.0	T	T	7.3	1.7	11.3	3.0	T	0.0	0.0	23.2
1949-50	0.0	0.0	0.0	T	0.3	0.0	2.0	10.2	0.0	0.3	0.0	0.0	13.0
1950-51	0.0	0.0	0.0	0.0	12.6	23.9	12.0	0.3	3.9	1.7	0.0	0.0	54.7
1951-52	0.0	0.0	0.0	T	23.4	30.7	12.7	2.4	2.9	1.7	0.0	0.0	76.8
1952-53	0.0	0.0	0.0	2.0	2.3	10.0	11.4	4.1	2.4	2.0	0.0	0.0	36.2
1953-54	0.0	0.0	0.0	0.0	12.8	16.3	14.3	12.0	12.2	T	0.3	0.0	71.2
1954-55	0.0	0.0	0.0	0.3	6.0	23.9	12.7	14.0	0.7	T	0.0	0.0	71.9
1955-56	0.0	0.0	0.0	T	11.4	8.6	12.7	13.0	0.3	2.0	0.0	0.0	53.1
1956-57	0.0	0.0	0.0	0.0	11.1	15.7	15.4	4.2	2.0	0.3	0.0	0.0	48.8
1957-58	0.0	0.0	0.0	T	3.0	17.0	18.0	20.1	4.0	T	0.0	0.0	62.1
1958-59	0.0	0.0	0.0	0.0	0.7	19.0	13.3	0.0	12.0	T	0.0	0.0	45.0
1959-60	0.0	0.0	0.0	0.0	13.1	8.7	12.6	20.3	25.0	0.7	T	0.0	99.1
1960-61	0.0	0.0	0.0	T	10.1	14.4	20.7	12.1	1.0	13.1	T	0.0	71.0
1961-62	0.0	0.0	0.0	T	9.7	9.3	18.7	17.4	8.2	1.8	0.0	0.0	71.7
1962-63	0.0	0.0	0.0	0.6	3.0	11.5	10.4	21.7	10.0	0.9	0.0	0.0	102.0
1963-64	0.0	0.0	0.0	0.0	7.2	25.0	10.0	14.4	22.7	0.9	0.0	0.0	79.0
1964-65	0.0	0.0	0.0	T	18.3	10.0	14.7	20.1	30.0	0.4	0.0	0.0	87.7
1965-66	0.0	0.0	0.0	2.0	7.3	8.3	26.0	10.7	11.0	0.4	0.0	0.0	75.5
1966-67	0.0	0.0	T	T	10.2	18.0	30.0	31.5	11.2	2.0	0.0	0.0	110.0
1967-68	0.0	0.0	0.0	0.0	7.0	12.5	12.6	20.1	8.7	1.9	T	0.0	63.4
1968-69	0.0	0.0	0.0	T	0.0	27.0	24.1	19.0	0.0	T	0.0	0.0	72.0
1969-70	0.0	0.0	0.0	T	10.3	17.1	24.0	11.8	16.7	7.0	0.0	0.0	86.8
1970-71	0.0	0.0	0.0	0.0	11.0	20.0	22.5	7.8	10.1	2.6	0.0	0.0	82.2
1971-72	0.0	0.0	0.0	0.0	10.2	4.6	19.2	21.2	10.1	7.1	0.0	0.0	84.2
1972-73	0.0	0.0	0.0	0.0	1.0	19.7	9.8	11.0	6.9	1.7	0.0	0.0	56.1
1973-74	0.0	0.0	0.0	0.0	1.0	22.0	14.5	11.0	9.5	1.2	0.0	0.0	60.7
1974-75	0.0	0.0	0.0	0.0	7.9	19.0	9.2	15.9	15.0	3.6	0.0	0.0	70.7
1975-76	0.0	0.0	0.0	0.0	10.7	14.0	21.2	13.0	2.0	0.0	0.1	0.0	70.8
1976-77	0.0	0.0	0.0	0.0	21.0	27.6	27.2	13.0	13.0	2.9	0.0	0.0	105.7
1977-78	0.0	0.0	0.0	0.3	10.4	33.6	36.3	16.6	51	T	T	0.0	172.0
78-79	0.0	0.0	0.0	0.0	7.5	20.4	48.1	15.5					
RECORD MEAN	0.0	0.0	T	0.7	9.0	17.0	18.8	18.0	9.6	2.1	T	0.0	86.9

95.1

# indicates a station move or relocation of instruments. See Station Location table.

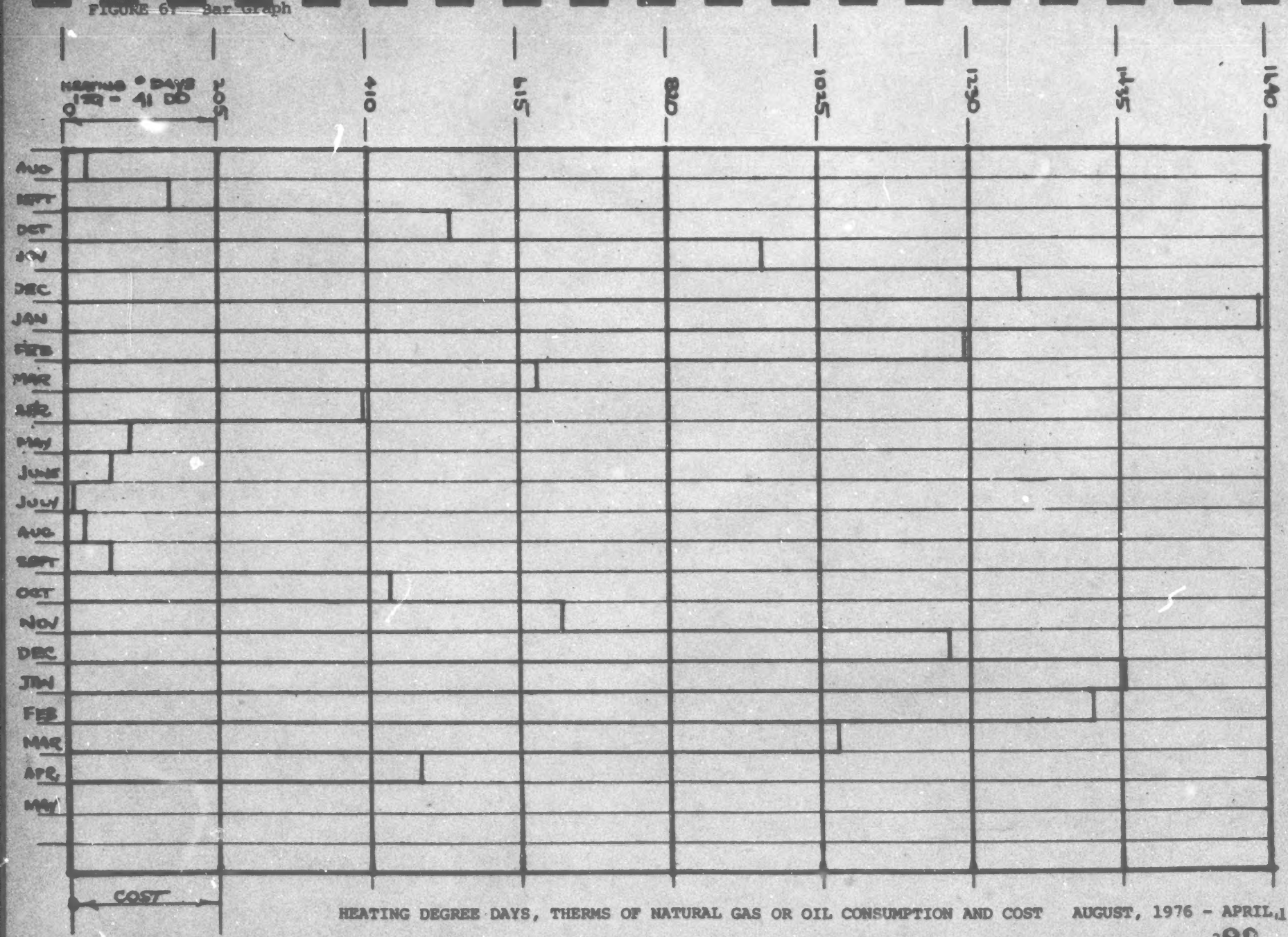
Record mean values shown are means through the current year for the period beginning in 1896 for temperature and precipitation, 1948 for snowfall. Temperature and degree day data are from Cooperative locations through March 1939 and from Airport locations thereafter. Precipitation and snowfall data are from Cooperative locations through July 1939 and from Airport locations thereafter.

FIGURE 6: Bar Graph



COOLING DEGREE DAYS, THERMS OF ELECTRICAL CONSUMPTION AND COST JULY, 1976 - APRIL, 1978

FIGURE 61 Bar Graph



HEATING DEGREE DAYS, THERMS OF NATURAL GAS OR OIL CONSUMPTION AND COST AUGUST, 1976 - APRIL, 1

FIELD OBSERVATIONS - PRACTICUM 24 HOURS

The students are formally introduced to some of the more common occupations that utilize individual components of the Project EFFECT Training Curriculum. They observe professionals in energy technology such as utilities technicians, insulation contractors and building inspectors. They are expected to keep detailed logs of the daily routine of activities that constitute each observation.

PRE-REQUISITES: Didactic portion of curriculum

COGNITIVE SKILLS:

Reading and writing level: 8th grade

Math level: 8th grade

Dexterity: Keep pace with field representatives as they proceed through buildings

Spatial orientation: Read blueprints, read schematics

Other: Communication skills (ability to ask concise and relevant questions)

FIELD OBSERVATIONS - PRACTICUM

OBJECTIVES

1) Document how professionals in energy technology perform their individual tasks.

2) Objectivaly assess the professionals' level of interest in their respective jobs.

3) Gain practical experience in meeting the public on a one to one basis.

FIELD OBSERVATIONS SYLLABUS

Session #	Hours	Objectives	Observation Site
1	3	1,2,3	ACTION, Inc. - Meeting with weatherization crew leaders and director; Observe and directed practice of caulking and weather-stripping; Observation of insulation application.
2	3		University of Notre Dame Power Plant - Meeting with Plant Engineer, tour of coal burning plant.
3	3		South Bend Building Inspectors - Participate in field inspections of sub-standard housing with building inspectors.
4	3		Bendix Corporation: Energy Systems Division - Meeting with Plant Engineer; tour of plant with emphasis on energy and environmental systems control, including pollution control on ventilation system and recirculation of filtered heated air to reduce heating load.
5	3		Northern Indiana Public Service Company (Gas Company) - Workshop at central office conducted by customer service representatives including overview of operations, consumer rights and services, and tour of facility.
6	3		Leon Yoder, Inc. - Building Contractor - Tour of new homes complete and under construction, with emphasis on energy-saving features and materials.
7	3		Joseph Donlon, Architect - Meeting at firm's central office; description of HUD and FHA requirements for publicly financed multi-family residences including apartment complex for elderly; special energy efficiency measures used in all-electric multi-family

FIELD OBSERVATIONS SYLLABUS CONTINUED

Session #	Hours	Objectives	Observation Site
7 continued			residences; and cost savings realized by adding insulation to previously insulated apartment buildings.
8	3		Indiana and Michigan Electric Company - Workshop conducted by Field Representatives and manager of Customer Relations. Overview of role of Service Representatives; consumer rights and services.

ENERGY USE SURVEYS - PRACTICUM 111 HOURS

The students have learned through the various modules how to conduct all of the separate components of the energy use survey. During this phase of the training, the students synthesize and practice their skills by performing energy use surveys on local residences. Students are assigned structures of increasing complexity which they audit in small groups with gradually decreasing supervision. As the students demonstrate greater competency, they are allowed to work on a more independent basis. Finally, students must attain "independent auditor" status by doing an independent energy survey and undergoing an oral examination covering all aspects of the audit. Following this, the student accompanied by an instructor, delivers and explains the audit report to the client.

PRE-REQUISITE: Math, all technical modules

COGNITIVE SKILLS:

Reading and writing level: 8th grade

Math level: Algebra, graphics

Dexterity: Ability to inspect buildings

Spatial orientation: Draw floor plans, use basic graphics

ENERGY USE SURVEY - PRACTICUM

OBJECTIVES

1) Conduct independent on-site energy use surveys of residential and light commercial structures.

2) Conduct comprehensive billing audit.

3) Evaluate collected data and compile report.

4) Communicate results of audit to owner/resident.

ENERGY USE SURVEY - PRACTICUM - SYLLABUS

Session #	Hours	Objectives	Topic
1 (Week 1)	12	1,2,3	Supervised audit: each team of 5 audits one home with an instructor. Team members share data, divide responsibility for completing separate audit components.
2 (Week 2)	12	1,2,3	Supervised audit: smaller team audits one home - data collection conducted on own, instructor supervises computation and assembling of audit components.
3	9	2	Computer Instruction: computerized Billing Audit - use of deck-writer, entering data, etc.
4	3	4	Demonstration and practice: Delivering audit report to client - answering client questions, explaining Energy Conservation Opportunities, involving client in planning changes.
5 (Week 3)	18	1,2,3	Semi-supervised audits: Audit two homes in teams of two. Complete billing audit and compile report. Instructor advises when necessary.
6 (Week 4)	27	1,2.3,4	Semi-supervised audits continue. Each team audits at least one more residence and prepares report with instructor's advice.
7 (Week 5)	3	1,2,3,4	INDEPENDENT AUDIT ASSESSMENT: Upon completion of one supervised and two semi-supervised audits, each student's competency is individually assessed by an instructor, at a residence. Characteristics of the structure are pointed out and the student is asked to give recommendations. Finally, the student delivers an audit report to a client, with an instructor monitoring.

ENERGY USE SURVEY - PRACTICUM - CONTINUED

Session #	Hours	Objectives	Topic
8	27	1,2,3	Semi-supervised and independent audits continue
9 (Week 6)	24		Independent audits - each trainee completes 2-4 residential and/or 1-2 light commercial audits
10 (Week 7)	24		Independent audits continue
11 (Week 8)	18		Independent audits continue

PROJECT EFFECT

COST CALCULATIONS AND ENERGY USE SURVEY
TECHNICAL TERM ACRONYMS

HEATING CALCULATIONS

AEC-H = Annual Energy Consumption-Heating
AFC-H = Annual Fuel Consumption-Heating
CHF = Climatic Factor for Heating
FF = Fuel Factor
DHL = Design Heating Load
DHF = District Heating Factor
DTD = Design Temperature Difference
Eff = Efficiency
Th = Therms
Btu = British Thermal Units
ccf = 100 cubic feet natural gas
gal = Gallon(s)
Kwh = Kilowatt hours of electricity

COOLING CALCULATIONS

AEC-C = Annual Energy Consumption-Cooling
AFC-C = Annual Fuel Consumption-Cooling
CFC = Climatic Factor for Cooling
DCL = Design Cooling Load
EER = Energy Efficiency Ratio
EPR = Equipment Power Rating
COH = Cooling Equipment Operating Time

HOT WATER CALCULATIONS

AEC-HW = Annual Energy Consumption-Hot Water
AFC-HW = Annual Fuel Consumption-Hot Water
AHW = Annual Hot Water Consumption
WHW = Weekly Hot Water Consumption
ΔT_w = Hot Water Thermostatsetting Minus Cold Water Input Temperatur

COST CALCULATIONS

ECO = Energy Conservation Opportunities
AES = Annual Energy Savings
AFS = Annual Fuel Savings
FP = Fuel Price
ADC = Annual Dollar Cost
ADS = Annual Dollar Savings
FC = First Cost
PP = Payback Period
SPP = Simple Payback Period
DPP = Discounted Payback Period
SIR = Savings to Investment Ratio
ROI = Return on Investment
OC = Operating Cost
LCC = Life Cycle Costing
UPVF - Uniform Present Value Factor
AEI = Annual Energy Index
SHI = Space Heating Index